Developing a Conceptual Model of Duck Hunters' Experiences to help Task Forces Understand Reasons Underlying Preferences For Season Dates

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Prepared by:

Jody W. Enck and
Heather A. Van Den Berg
Human Dimensions Research Unit
Department of Natural Resources
Cornell University

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EXECUTIVE SUMMARY

Introduction

The New York State Department of Environmental Conservation (DEC) started using Task Forces comprised of hunter representatives beginning in 1997 to recommend duck hunting season dates in the Western, Northeastern, and Southeastern waterfowl management zones. In 2005, the DEC waterfowl management team asked staff with the Human Dimensions Research Unit (HDRU) in Cornell University's Department of Natural Resources to conduct a statewide mail survey of duck hunters to obtain information to be used by the Task Forces about season date preferences and reasons underlying those preferences. The survey revealed four main reasons for season date preferences, regardless of zone: (1) when the most ducks are around, (2) when hunters have the best chance to take their favorite kinds of ducks, (3) when the weather is best for duck hunting, and (4) when hunters have time to hunt.

DEC sponsored a workshop for Task Force members and other avid duck hunters on 24 March 2007 in Cortland, NY at which results of the survey were presented. Two additional purposes of the workshop were: (1) engage Hunter Task Force members in discussions about how they interpreted the study findings, and (2) begin building a conceptual model that linked together (a) the reasons underlying season date preferences, (b) hunter-duck and hunter-hunter "events" or interactions associated with various interpretations of those reasons, and (c) experience satisfaction perceived by duck hunters. Our intent was to build a conceptual model to help Task Force members make the best possible recommendations about season dates.

Methods

The workshop was attended by 14 hunter representatives, 9 DEC staff, and 2 HDRU staff. During the workshop, J. Enck (HDRU) presented a summary of results from the 2005 statewide survey. This was followed by 2.5 hours of multi-part, structured discussion (see Appendix I) facilitated by J. Enck, with notes recorded on flip charts by H. Van Den Berg. It should be noted that the hunter representatives all were "more-avid" duck hunters, and many of the points they raised during the discussion were assumptions about "less-avid" hunters. Statewide, about 74% of duck hunters are "more-avid" and the remaining 26% are "less-avid."

The first part of the discussion explored various possible interpretations for the four main reasons underlying duck hunters' preferences for season dates. We then discussed how the various possible interpretations might influence particular experiences hunters have while hunting, like seeing ducks and shooting at ducks. Based on flip-chart notes recoded at the workshop, we further developed conceptual models reflecting participants' assumptions and beliefs about interpretations of the main reasons underlying duck hunters' season date preferences, and how those interpretations related to levels of satisfaction duck hunters derive from their experiences while hunting.

To develop the conceptual model, we followed a multi-step process that included: (1) defining the management problem and purpose of the conceptual model, (2) identifying and defining important variables, (3) describing reference modes showing how those variables typically change or "behave" over time in the absence of other variables, (4) evaluating assumed

relationships between variables, (5) developing dynamic hypotheses about the model structure necessary to produce the model "behavior" described in #4. Our purpose for developing this model was to show the kinds of benefits that can result from conceptual modeling, not to develop the single model that reflects how and why duck hunters' experiences occur as they do.

Results

Brain-storming various interpretations of reasons for hunting season preferences:

- Workshop participants identified many possible interpretations for each of the main reasons underlying season date preferences.

- Most interpretations were based on their own experiences as "more-avid duck hunters" and they believed – despite survey results to the contrary – that most duck hunters were "less-avid" with little knowledge of "when the most ducks are around" and that most "less-avid" hunters do not *actually* have a favorite kind of duck despite the survey finding that "when I have the best chance to take my favorite kinds of ducks" is a major reason underlying season date preferences.

- Participants believed that hunters' duck-hunting experiences were linked conceptually to "micro" (site-specific) or "macro" (area-wide) weather phenomena or habitat characteristics, rather than to hunter-duck or hunter-hunter interactions that might change in relation to changing season dates. That is, highly variable factors that may be unique to each hunting location influence experiences, and that the unpredictability of these factors precludes any feedback from experience satisfaction to hunters' intentions to hunt ducks on some subsequent day.

- Participants were unsure about how duck hunters' expectations about experiences or hunters' satisfaction with experiences were conceptually related to hunters' intentions to go duck hunting.

- In summary, beliefs about factors that might affect hunting experiences, and the lack of understandings about feedback on hunters' intentions to hunt again indicate a linear conception of how hunters' experiences occur. That is, participants did not consider duck hunting as a *system of factors* influencing each other through feedback, but rather conceive of duck hunting as more of an "equation" in which some combination of largely uncontrollable factors equals either a satisfying or dissatisfying experience.

- Given this linear conception of duck hunting, there is no opportunity to understand how reasons identified in the 2005 statewide survey of duck hunters as underlying preferences for season dates possibly could be related to hunting satisfaction, nor how hunting satisfaction could possibly be related to their intentions to go duck hunting or to change their behaviors while hunting. We believe that Hunter Task Force members can make more informed decisions if they based those decisions on a conceptual model of duck hunting as a *system of interactions* with various feedback mechanisms rather than a

linear, deterministic "equation" of factors "adding up" to cause different amounts of satisfaction.

Towards development of a conceptual model of duck hunters' experiences:

- Two important assumptions used for developing (or literally drawing a picture of) a conceptual model of a system of factors affecting duck hunting experiences were:

  1. the greatest understanding can be found in patterns of *model behavior* that cause *events* (e.g., shooting at ducks, going duck hunting *again*) to occur or change in intensity over time.

  2. the most successful management policies and interventions (e.g., like recommending the best possible season dates) will affect *model structure* so that *model behavior* is improved and "bad" *events* become less frequent while "good" *events* become more frequent.

- A necessary first step in model development was to articulate the "management problem" to be addressed. This step revealed confusion about three kinds of satisfaction with respect to duck hunting: (1) decision process satisfaction, (2) decision outcome satisfaction, and (3) experience satisfaction.

  1. DEC has addressed satisfaction with the process used for deciding season dates (i.e., decision process satisfaction) by implementing Hunter Task Forces.

  2. Duck hunters evaluate how satisfied they are with the outcome of the decision (i.e., decision outcome satisfaction) when they see the published dates and consider them in the context of the reasons underlying their preferences for dates.

  3. When duck hunters then go hunting, they evaluate the degree to which the kinds of experiences they have during the open season (i.e., experience satisfaction) are consistent with the major reasons underlying their preferences.

- Identifying and defining important variables and describing participants' initial beliefs about how those variables typically change or "behave" over time in the absence of other variables allowed us to improve on the linear, deterministic equation-type ideas and to produce a model showing duck hunting as a system of relationships that feedback on one another.

- This process allowed us to reduce complexity greatly in the revised model by including only those components that vary according to some pattern, and it allowed us to identify the kinds of ecological and social data likely to be of greatest use to Task Force members in deciding about recommendations for season dates.

- Of special importance was the identification of plausible positive and negative impacts of importance to duck hunters and which influence the degree to which hunters are satisfied or dissatisfied with their duck-hunting experiences.

- Finally, we developed (i.e., drew pictures of) several dynamic hypotheses about the model structure necessary to produce the changes in model "behavior" necessary to represent the most likely interpretations for each of the main reasons underlying duck hunters' preferences for season dates.

- The model we developed interprets preferences for season dates in the context of expected interactions between hunters and ducks and among hunters, links those preferences to experience satisfaction, and incorporates ideas about feedback that occurs in the system.

Short- and Long-term Information Needs:

- The conceptual model we developed is our model, not a model developed by Task Force members. It should be considered to be only an example of a model, demonstrating the major benefits that can result from adopting such an approach for decision making. If DEC and Task Force members develop a conceptual model for decision-making, several kinds of information will be needed to ensure its greatest utility:

    1. Information is needed from the DEC waterfowl management team about the validity of our assumptions related to hunter satisfaction – that the three different kinds described above exist, and that the main purpose of the Task Forces is to recommend season dates that result in the highest possible experience satisfaction.

    2. Information is needed from Hunter Task Force members whether they agree with the assumptions we articulated in the model, particularly pertaining to the system of factors and feedbacks in that part of the model showing the basic duck hunting system.

    3. Further, Task Force members should discuss and revise the dynamic hypotheses about how the reasons underlying duck hunters' preferences for season dates relate to their levels of experience satisfaction, and ultimately their behaviors.

    4. Finally, information is needed from Task Force members about what they think their decision-making role is vis-à-vis season dates: maximize opportunity for all kinds of duck hunters (e.g., dabbling vs. diving duck hunters, warm vs. cold weather hunters, shallow water vs. deep water), maximize participation (i.e., retention), or provide some satisfying experiences for everyone because how they use the model will be affected by which role they are trying to fulfill.

    5. Also, standardized information needed from duck hunters in the different management zones will be: verification of important impacts with the greatest influence on experience satisfaction, desirable/tolerable levels of those impacts,

and current levels of duck hunter satisfaction that can be calibrated with comparisons of currently experienced levels of impacts and desirable/tolerable levels.

Conclusions

The workshop revealed that participants currently lack an approach for either evaluating possible interpretations of reasons underlying season date preferences or linking them specifically to duck hunters' experience satisfaction. We believe that a conceptual modeling approach can best meet this need, as well as provide other important benefits. One such benefit is to increase understanding about the distinction among process, outcome, and experience satisfaction in the context of duck hunting and to help separate the roles and responsibilities of DEC staff and the Task Forces. Another benefit is to improve understanding of the reasons underlying duck hunters' preferences for season dates, and to articulate that understanding in the form of a conceptual model. Also, conceptual modeling can help identify some plausible "events" and related perceptions (i.e., hunter identified impacts) that influence experience satisfaction.

ACKNOWLEDGMENTS

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INTRODUCTION AND BACKGROUND

The New York State Department of Environmental Conservation (DEC) annually sets dates for duck hunting within in 4 major zones: Western, Northeastern, Southeastern, and Long Island. To ensure that hunter interests and concerns are incorporated into decisions about season dates, DEC started using Task Forces comprised of hunter representatives beginning in 1997 to recommend duck hunting season dates in the Western, Northeastern, and Southeastern zones (Enck et al. 2006a). Anecdotal evidence suggests that the use of Task Forces has worked well, but no formal evaluation had been done as of 2005 to assess whether the season dates recommended by Task Forces reflected preferences of the broader population of duck hunters.

In 2005, the DEC waterfowl management team asked staff with the Human Dimensions Research Unit (HDRU) in Cornell University's Department of Natural Resources to conduct a statewide mail survey of duck hunters to obtain information about season date preferences and reasons underlying those preferences. That survey resulted in >1,800 total responses, with >395 responses from each of the 4 main zones (Enck et al. 2006a). Regardless of zone, hunters indicated that the most important reasons why they preferred to hunt during specific time periods were: (1) when the most ducks are around, (2) when hunters have the best chance to take their favorite kinds of ducks, (3) when the weather is best for duck hunting, and (4) when hunters have time to hunt. Additional analyses revealed that duck hunters preferring different time periods (e.g., early season opportunities vs. late season opportunities) indicated that the same reasons were "very important." These results suggested the possibility that the general reasons enumerated above may have different specific meanings for different duck hunters.

To explore this possibility, DEC sponsored a workshop for Task Force members and representatives of waterfowl organizations on 24 March 2007 in Cortland, NY. Among the various purposes of the workshop were these: (1) provide Hunter Task Force members with a summary of the 2005 statewide duck hunter study results, (2) help them develop a better understanding of the results so they could use them when meeting in late spring to recommend season dates for the fall 2007 duck hunting season, and (3) identify additional data needed by Task Force members to make the best possible recommendations about season dates.

METHODS

The workshop was attended by 14 hunter representatives, 9 DEC staff, and 2 HDRU staff. During the workshop, J. Enck (HDRU) presented a summary of results from the 2005 statewide survey. This was followed by 2.5 hours of multi-part, structured discussion (see Appendix I) facilitated by J. Enck, with notes recorded on flip charts by H. Van Den Berg. It should be noted that the hunter representatives all were "more-avid" duck hunters, and many of the points they raised during the discussion were assumptions about "less-avid" hunters. Statewide, about 74% of duck hunters are "more-avid" and the remaining 26% are "less-avid" (Enck et al. 2006).

Part I of the discussion explored various possible meanings for the 4 most important reasons underlying duck hunters' preferences for season dates. Part II focused on how the various possible interpretations might influence particular experiences hunters might have while

hunting ducks: seeing ducks, seeing ducks that are in-range, intending to take shots at ducks in-range, and shooting at those ducks. Results from Parts I and II are presented in detail below.

We had planned Part III to focus on identifying ecological and human dimensions data (i.e., the science on which decisions should be based) needed by Task Force members to make the best possible recommendations about season dates, depending on the interpretation of reasons associated with preferences for season dates. However, time constraints precluded this part of the discussion. Therefore, HDRU staff completed this task after the workshop.

RESULTS

Results of the workshop are presented in 3 parts. In Part I, we present the various interpretations brain-stormed by workshop participants of the 4 main reasons underlying duck hunters' preferences for season dates. Data for this part are presented following the structured format used in the discussion. In Part II, we develop a simple, conceptual model, based on insights from the discussion, showing how hunting experiences can be depicted as a series of interacting events between hunters and ducks. In Part III, we use that conceptual model as a tool for evaluating the plausibility of the various brain-stormed interpretations by discussing how these would affect model behavior and structure.

Part 1: Exploring Variation in Interpretations of Reasons for Season Date Preferences

When I Have Time to Hunt:

Of the 4 reasons explored, we expected that "when I have time to hunt" would be the most straightforward to participants. However, several interpretations of "time to hunt" were revealed.

"Free Time." Work obligations and family responsibilities reduce the amount of time available for hunting ducks. Participants indicated that for some people, time to hunt might occur on holidays – especially "minor holidays" that the hunter might have off from work, but other family members might have to work or go to school. So, the hunter might not be "busy" interacting with other family members. These holidays likely include Veteran's Day and Columbus Day. Indeed, a participant said it was a mistake to have had Youth Waterfowl Weekend occur on the Sunday and Monday of Columbus Day weekend because most youth were not off from school on Columbus Day as they anticipated.

Holidays Often Are Not "Free Time." Other participants noted that many holidays do not reflect very well "when I have time to hunt." Not everyone has every "minor" holiday off. "Major" holidays (e.g., Thanksgiving, Christmas) may be traditional times for other family activities, and it may be harder to hunt on those days than regular work days on which the hunter could use vacation leave.

Days Before and After Holidays. Several participants mentioned that days surrounding holidays might better reflect time available for hunting ducks. The discussion revealed that many hunters often take vacation days, especially around "major" holidays, like Christmas Day

or New Year's Day. Hunters may spend some of that vacation time engaged in non-hunting family activities, but also may use some of it for duck hunting.

Duck Hunting vs. Other Outdoor Pursuits. When duck hunters have time "free" from work obligations and family responsibilities, there usually are a number of other hunting, trapping, fishing, etc. opportunities from which to choose. Participants believed this may be especially true for less-avid duck hunters who may not be heavily invested in equipment for duck hunting. In this context, "when I have time to hunt" could mean when there is the least potential competition with other sporting seasons.

How did Workshop Participants Relate Factors Affecting "Intention to Hunt" to "When I Have Time to Hunt Ducks"?

To examine the degree to which workshop participants incorporated results of the 2005 survey (presented to them earlier in the workshop) into their considerations of factors affecting when hunters most likely intend to hunt ducks, we asked them to list and discuss factors they believed directly influence hunters' intentions to go duck hunting. Theoretically (e.g., according to the theory of planned behavior), hunters' beliefs about the kinds of hunting experiences they will have at different time periods should be major influences on their intentions. Further, these beliefs should relate directly to the other three main reasons underlying hunters' preferences for season dates: (1) "when the most ducks are around," (2) "when I have the best chance to take my favorite kinds of ducks," and (3) "when the weather is best for duck hunting."

None of the brain-stormed factors seemed closely related to the survey results pertaining to reasons underlying preferences for season dates. Instead, participants identified these factors: (1) when hunters' companions can hunt ducks, (2) when hunters have access to a place to hunt ducks within a reasonable distance of home, (3) tradition, or dates when they usually hunt, (4) availability of duck food sources in the local area, (5) when the total hunting experience will be most satisfying, and (6) timing of in-migration of ducks "so you don't always shoot at the same birds and drive them out of the area."

When the Most Ducks Are Around:

Participants focused on various interpretations for the word "most" rather than discussing if hunters think about "ducks" in a generic sense vs. some variation on that word (e.g., as in most of my favorite kinds of ducks). Prior to the workshop, we had hypothesized that "most ducks" was tied to abundance, and more specifically, to numbers of ducks in specific hunting locations, or habitat types hunted most frequently. As noted below, participants focused less on total abundance (some actually disputed that abundance was a useful concept in duck hunting), or on numbers of ducks in various habitats, and more on the concept of duck availability.

Influences on Numbers of Ducks in the General Area. Participants differentiated between the numbers of ducks in the general area (e.g., management zone, or county) and numbers of ducks in local areas used by hunters. Most participants believed that most hunters only consider the number of ducks they see in their favorite hunting areas. A few participants suggested that most hunters do not seem to know how to find ducks that occur in the general area

(e.g., county), but that may be more difficult to locate after the first few days of the hunting season because the ducks have vacated the most heavily hunted wetlands.

According to participants, a major effect on numbers of ducks in the general area is migration – both out-migration of locally produced ducks, and in-migration of birds produced elsewhere. Some mentioned a migration peak, or a period when there is the greatest absolute numbers of ducks in the general area. Others mentioned that the situation was more complex. According to a participant from the Southeastern Zone, "the first ducks we hunt are locally produced ducks, and most of those birds are gone [from the general area] by November 10th."

However, the influence of out-migration on numbers of ducks was debated by participants. Some believed that locally produced birds "moved out of the area after about the third day of hunting." Others believed that these ducks did not leave the area, but that they found refuge in areas that most hunters could not easily hunt or that were not open to hunting.

A complicating factor was participants' use of the terms "abundance," "availability," and "accessibility." Participants described "abundance" as synonymous with magnitude – or the relative size of the population. Further, most participants believed the term "abundance" is not relevant if ducks are not also "accessible" and "available" to hunters. "Accessible" probably is most closely related to the notion of hunting access. Ducks are not accessible when they occur on posted property. "Available" was the term participants thought was perhaps most relevant. It seemed to indicate ducks that not only occurred in the general area and were accessible, but also were vulnerable to a great enough extent that hunters have a reasonable chance of harvesting some if "the hunters know what they are doing."

"Macro" Influences on Numbers of Ducks in Specific Places. Participants also differentiated between seasonal or what they called "macro" influences on duck numbers and day-to-day or "micro" influences that might particularly affect local areas. Everyone agreed that ducks are not distributed evenly across the landscape because of "macro" influences. In general, the widest distribution occurs early in the hunting season (i.e., before freeze-up). However, not all duck species, or flocks within species, feed in wetlands. Dabbling ducks in particular were noted to utilize agricultural fields for feeding, and harvest phenology of crops was discussed as an important influence on presence and distribution of non-wetland feeding sites.

Participants believed that most agricultural crops usually are harvested by the middle of the hunting season providing more wide-spread feeding sites. However, shallow-water marshes and ponds are more likely to be frozen later in the season. Roosting, loafing, and feeding sites in shallow wetlands are less available to ducks – and for hunting ducks – at that time.

"Micro" Influences on Numbers of Ducks in Specific Places. Daily weather conditions, particularly wind speed and direction, and presence-absence of precipitation or fog, are perhaps the most important "micro" influences on duck "abundance" in local areas. These conditions also may influence whether the area can be hunted successfully, even if ducks are using it – that is, whether ducks will be "available to hunters." In general, higher winds and wind directions that "disturb" ducks cause them move to more secure (i.e., out-of-the-weather) locations. Duck abundance, availability to hunters, and vulnerability to harvest can be high in these places, if

ducks also are accessible to hunters. Precipitation and fog also tend to make ducks more vulnerable to harvest if hunters are using calls and decoys.

How do Hunters Know "When the Most Ducks are Around"?

Responses to this follow-up question grouped into several categories: (1) communication channels, (2) types of habitats or places typically hunted, and (3) types of ducks hunted. Communication channels pertained to how hunters find out when the most ducks are around. Channels include personal observations of ducks while hunters are driving to or from work and during other non-hunting activities, word-of-mouth from friends, and observations by hunters while they are hunting.

Some participants noted that hunters may develop differential understanding of when the most ducks are around depending on how specific they are to particular habitats or localities for hunting. Duck hunters who have one particular "home water" that they hunt faithfully and without variation may have a less realistic assessment of duck abundance or availability than hunters who hunt multiple habitats. Participants assumed that less-avid hunters were most likely to have a "home water" and less likely to hunt bigger, open water where ducks would be available during more of the season. They also assumed that more-avid hunters typically made a higher financial investment in duck hunting, and would have the equipment to hunt bigger water.

Finally, participants noted that for some hunters, "when the most ducks are around," may be species dependent. For example, Wood Ducks generally may be more abundant and available early in the hunting season. Later, this species may still occur in lesser numbers, and still be available to hunters who "know where Wood Ducks hide out," but may not be available to most hunters who have just 1 or 2 "home waters." These hunters may perceive more ducks to be around very early in the season compared to later.

Also worth noting, most participants clearly differentiated the general duck-hunter population from themselves as Task Force members who are to consider "when the most ducks are around" in their recommendations for season dates. Members of the general duck-hunter population were assumed to trust Task Force members to choose season dates when the most ducks would be around. Thus, when hunters go out on opening day, they can have a reasonable expectation to see and harvest ducks. Participants also noted that some duck hunters probably have little knowledge of duck abundance or availability, but believe the most ducks are around when those hunters traditionally go duck hunting.

On the other hand, participants acknowledged that it was very difficult to predict when the most ducks would be around, mostly because it is hard to predict when the bulk of migration will occur. Historical patterns of duck migration can be used to gain insight. However, year-to-year variation in migration patterns can affect if the season is open when ducks are abundant and available – even if dates are kept consistent over some number of years.

If "seeing is believing," in terms of when hunters believe the most ducks are around, what factors influence the number of ducks that hunters see while hunting?

We asked this follow-up question because we assumed that many hunters might develop a perception about "when the most ducks are around" based on how many they see while hunting. As noted above, this assumption may not be entirely valid. Nonetheless, different hunters likely see different number of ducks on any given day, as well as different percentages of the ducks that are "available" to hunters on any given day. In general, the numerous factors that participants believed might influence how many ducks hunters see while they are hunting mirrored the "macro" and "micro" influences on duck abundance.

"Macro" widespread or seasonal influences. "Macro" factors seemed related to when the hunting day occurred with respect to: the fall migration "cycle," how many ducks already have been harvested, crop-harvest phenology, and freeze-up of shallow water-bodies. Overall, more ducks probably will be seen on days when more ducks are in the area because of usual migration patterns. Also, early in the hunting season, many locally produced ducks may be harvested before migrants move into the area, resulting in lower duck abundance but especially fewer ducks available in the most easily accessed hunting areas.

Crop harvest phenology could either increase or decrease the number of ducks seen by hunters, regardless of duck abundance, depending on how close harvested fields (possible feeding locations) occur to the hunting location, and whether harvested fields are relatively few and localized or many and widespread. Similarly, freeze-up could decrease the number of ducks seen by hunters who hunt in shallow waters, but could increase the number of ducks seen, regardless of absolute duck abundance, by hunters who hunt in deeper waters that remain open.

"Micro" localized or daily influences. "Micro" factors influence the number of duck observations regardless of overall duck abundance locally. Daily weather conditions (e.g., presence-absence of precipitation and wind, and wind direction) affect whether ducks are "disturbed" and fly around seeking more protected locations to feed or rest. Also, more ducks probably will be seen on days when more hunters are afield because of the added disturbance.

Other longer-term influences. Participants also listed some factors that might affect the number of ducks seen in a specific location over the long-term rather than on any given day. Perhaps the most important of these is factors is the trend in the duck population, with higher abundance resulting in more observations – all other things being equal. One participant noted that human development in what had been farmland near some of his favorite duck-hunting spots had decreased feeding locations and had affected local flight patterns of ducks. Another believed that increases in the acreage of state/federal areas managed for waterfowl decrease the number of ducks using private lands that are traditionally hunted by some hunters.

When I Have the Best Chance to Take My Favorite Kinds of Ducks:

Again, participants differentiated between less-avid and more-avid duck hunters (i.e., themselves), but still believed there were various possible interpretations within those hunter categories. Prior to the discussion, we had anticipated that "favorite" would be linked to species,

type of duck (diver vs. dabbler), or sex of bird. Further, we expected that the concept of "favorite" would be static or stable throughout the season. Both of these expectations were brought into question by the discussion.

Favorite ducks of less-avid duck hunters. Participants believed that the "favorite" ducks of less-avid hunters are ducks that: (1) take less effort to hunt, or (2) "whatever ducks are around." Overall, less-avid duck hunters were assumed to be less discriminating about "favorite" ducks, perhaps because they lack skill necessary to identify ducks or because of their typically singular hunting styles. That is, they may have only one or two "home waters," usually shallow-water marshes, which are visited by common, dabbling duck species. Some participants believed that some less-avid or casual hunters may indeed have "favorite" species, but assumed that those hunters will (try to) harvest whatever duck comes within range.

Favorite ducks of more-avid duck hunters. "Favorite" ducks to more-avid hunters are: (1) the tastiest or more edible species, (2) well-marked drakes in high breeding plumage, or (3) perhaps dabblers vs. divers (or visa versa). It takes some identification skill to know a more edible species from one that is not as tasty, and some knowledge of duck molt to know that drakes usually "are more mature" and "look prettier" later in the season. One participant said his "favorite" ducks depend on the "whole experience of duck hunting," including style of hunting, cost, proximity of hunting area, and species involved. For that participant, "favorite" ducks changed over the course of the season depending on the memories they evoked.

Does Having a "Favorite Kind" of Duck Influence Shot Selection?

The answer to this follow-up question could influence both total duck harvest and harvest rate of different kinds of ducks. The magnitude of the influence would depend on (1) specificity of interpretations of "favorite kind" and (2) factors affecting hunters' intentions to pass-up shots at ducks other than their "favorite kind." If hunters' "favorite" ducks simply are those that are "easiest to take" or "whatever is around," having a "favorite" would not affect total harvest or harvest rate. Also, if various factors (e.g., perceived interference from other hunters, or perceived unavailability of "favorite" ducks) lessen hunters' intentions to pass up shots at ducks other then their "favorite" ones, then total harvest or harvest rate would not be affected.

One participant said, "if two ducks fly by a hunter – one a 'favorite kind' and the other not a favorite – then having a 'favorite' duck will influence which duck he shoots." Others indicated that whether shot selection is affected by having a "favorite kind" of duck might be influenced by a hunter's expectations about what kinds of ducks he/she might encounter on that hunting trip. If the hunter expects to have reasonable chances to take some of their "favorite kinds," then he/she might be more selective. Another believed that shot selection is influenced more by other factors such as whether the duck could be retrieved by his dog.

What does "Best Chance to Take" Mean in the Context of "Best Chance to Take Favorite Kinds of Ducks"?

We asked this follow-up question to explore if hunters might simply refer to the probability of taking their favorite kinds of ducks. Participants acknowledged that "best chance"

might be related to abundance. However, for some hunters, "best chance" referred to a "perfect set-up where ducks come right in to the intended spot." For participants, the "perfect set-up" differs depending on whether the person hunts in a farm field or in a wetland.

How do Hunters Know When They will have the "Best Chance to Take Favorite Kinds of Ducks"?

Because "when I have the best chance to take my favorite kinds of ducks" is such an important reason underlying season date preferences for many hunters (Enck et al. 2006a), we wanted to better understand how hunters know when they will have this best chance. Many participants believed hunters rely on experience – either their own or that of a more experienced hunting friend – to know when the best chances are likely to occur. To record their own experiences as part of an "historical reference," some participants keep a detailed hunting diary. Other participants rely on their knowledge of duck breeding areas (e.g., some species breed locally others farther away), migration patterns, and habitat use provide insights about when they will have the best chance to take their favorite kinds of ducks.

When the Weather is Best for Hunting Ducks:

Again, participants noted both "macro" and "micro" aspects to possible interpretations. Which of these aspects is most important could depend on: type of duck being hunted (i.e., divers vs. dabblers), type of habitat being hunted, and other characteristics of the hunting location. Perhaps the most important "macro" influence is the seasonal weather pattern that affects where duck numbers concentrate. When smaller ponds freeze, ducks concentrate on the larger bodies of water. The "best weather for hunting ducks" probably is different depending on whether someone is hunting the smaller ponds or the larger water bodies. Another "macro" influence is fall migration which affects overall duck abundance and species composition.

"Micro" influences pertain mostly to wind, although presence-absence and type of precipitation also can be important. Wind speed and direction greatly affect if birds will be "in the air moving around" and affect vulnerability of ducks to decoying. However, participants noted that the same wind speed and direction will not be "best" for every hunting location. Some places will be more protected from higher winds, and offer more protection if the wind is coming from a particular direction. Further, windy conditions can decrease likelihood of ducks coming into a decoy spread if the hunter chooses (or only has access to) the "wrong side of the pond."

Some participants believed avidity of survey respondents affected their meanings of "best weather for duck hunting." Other participants believed that meanings of "best weather" were so individualized as to be impossible to understand. For those who linked "best weather" to avidity, the general idea was that less-avid hunters probably think about "macro" aspects like seasonal weather patterns and timing of migration. Conversely, more-avid hunters probably think about "micro" aspects like daily weather conditions. As evidence for these beliefs, participants said, "fewer hunters hunt in bad weather," and "higher-quality hunters hunt late in the season when hunting conditions are not easy." Perhaps because of the belief that fewer, but "higher-quality" hunters hunted on days with more challenging weather conditions (i.e., the "best weather" for

hunting), participants said that weather conditions have a much greater influence on their decisions about when to go hunting than possible, negative hunter-hunter interactions.

Key Findings from Part I

- **Hunter representatives participating in the workshop (not DEC staff) all were "more-avid" duck hunters who made many assumptions about the experiences and beliefs of "less-avid" hunters.**
- **Workshop participants identified a wide variety of possible interpretations of each of the four main reasons underlying duck hunters' preferences for season dates (determined from the 2005 statewide survey)– leading some to express initially that the data were "not very useful," and others to express being "overwhelmed" by the complexity.**
- **Workshop participants generally ignored survey results, and did not conceptually link reasons underlying duck hunters' preferences for season dates to hunters' intentions to go duck hunting.**

Part II: Towards Development Of A Conceptual Model Of Duck Hunters' Experiences

One purpose of the workshop was to ascertain if, and how, changing season dates might affect hunters' experiences vis-à-vis the various reasons underlying preferences for season dates. To fulfill this purpose, we explored several questions with participants that allowed HDRU staff subsequently to work towards development of a simple, *conceptual model* to depict (or literally draw a picture of) relationships among hunters' experiences, and answer questions about why those experiences happen as they do. Simplistically, a true, but unsatisfying, answer to the question "why did the hunter harvest the duck" might be "because the duck was there and the hunter hadn't taken his limit yet." A deeper and more meaningful answer lies in patterns of *model behavior* that cause *events* (e.g., shooting at ducks, going duck hunting *again*) to occur or change in intensity over time. Here, behavior refers to outcomes of interactions among variables in the model, not hunter behavior – indeed hunter behavior is manifested in some of the events depicted in the model.

Models Aren't Just For Geeks:

Everyone uses models all the time. Most of the models we use are informal ones that we carry around in our heads without even realizing it. Because these informal models are not written down somewhere, they are called "conceptual models" or "mental models." Senge (1990:8) defined mental models as "...deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action."

Consider a morning duck hunting in marsh in late October somewhere in New York State. The hunters are in a good spot that has been productive before, they are well concealed in a blind, and have a nice spread of decoys in front of them. But they don't see any ducks that morning. Maybe the early migrants already left, or maybe the late migrants have not arrived yet. Maybe the weather is wrong. Maybe the ducks are feeding elsewhere, or maybe they were disturbed too much in that marsh the day before. All these possibilities – identified in Part I of this report – are theories that hunters use to explain the world around them. Those theories are indeed conceptual models.

Just carrying mental models around in our heads does not make them useful. It has been asserted that, "models are most useful when they lead to 'counterintuitive' results, which force [decision makers] to reexamine their intuitive understanding of the system" (Ford 1999:5). In addition, useful models require carefully describing one's assumptions and what is known about the parts of the system and how those parts interrelate.

Finally, the most useful models in a natural resource context are those that improve learning and understanding, rather than ones that try to predict the future. "Ecosystems are subjected to highly random inputs, such as weather, so it does not make sense for ecologists to construct models of high predictive power when basic inputs cannot be measured or predicted. Thus, ecological models are more often designed to improve our general understanding, or to guide research efforts" (Ford 1999:10).

What are model users supposed to learn or understand if natural resource models are not be used to predict the future? Some of the most important things to learn include: do all the decision makers have the same assumptions, which assumptions seem valid and which do not, what are the important variables to consider and what variables just add unnecessary complexity to the model. Perhaps the most important understanding to come out of a modeling process is to identify key rules of thumb. Some rules of thumb might be intuitive – e.g., a split season will provide moderate levels of satisfaction for all types of ducks hunters but high levels for few, or a split generally should include at least two weekends to provide opportunity for people who work during the week. Other rules of thumb might be counterintuitive – e.g., opening the season when the most people can hunt will lead to intolerable amounts of interference among hunters, hastening desertion from the ranks of hunters.[1]

[1] These rules of thumb are just examples, and may quite likely be incorrect.

Model Terminology:

Model behavior helps identify "pressure points" and imbalances" that cause or change *events* (Vennix 1996). For example, do certain relationships between variables always constrain the range of possible responses by another variable, or cause another to always respond or in a certain way? Behavior can be examined by graphing the change in a variable of interest over time. *Model structure* (what you see as boxes and arrows in the following figures) shows ecological and social variables (in boxes), and their various relationships (arrows), that generate patterns of model behavior. Events (e.g., seeing ducks, harvesting ducks) simply are snapshots in time of the patterns of model behavior.

An example of *events*, *behavior*, and *structure* in a *conceptual model* about choosing a college.

Going to college is an important event in the lives of many young Americans. Before 1970, most college students attended school close to home (Asher 2007). Over the next few decades, several societal trends made it more possible and acceptable to attend a college of choice rather than location. "The advent of cheap air travel--and the breakdown of regional differences due to television and migration of educated workers throughout the country--combined to make bright young people look nationally for college choices" (Asher 2007).

In this example, changing relationships among variables led to changing model behavior. Easier travel and loss of regional stigmas relieved some "pressures and imbalances" among variables affecting choice of a college. Specifically, as travel cost decreased, the distance from home that one could consider attending college increased.

However, other variables (model structure) affected whether that choice could be realized. As Asher (2007) noted, "[t]he problem is that young people and their families didn't catch on to the level of competition that this change entailed" and which was exacerbated by a large increase in the number of students who wanted to attend college before entering the workforce. Competition for admittance always existed, but the changes noted above made it imperative to recognize both the numbers of prospective students and the associated competition as part of the structure of the conceptual model people intuitively use when deciding about college.

That explanation may sound complicated, but it's not. Think about it this way. A series of events – seeing ducks, shooting at ducks, harvesting ducks – can result in a success-oriented hunter becoming satisfied (which is yet another event) because he got his limit or at least enough ducks to be satisfied. Alternatively, if a hunter does not experience enough of these events (e.g., sees or harvests too few ducks), he can become dissatisfied (a "bad" event) with the hunt. When the distinction between *events*, *model behavior*, and **model structure** is understood well, a conceptual model can become an important tool for making challenging wildlife management decisions.

Key Point: To the degree possible, successful management policies and interventions (e.g., like recommending the best possible season dates) will affect *model structure* so that *model behavior* is improved and "bad" *events* become less frequent while "good" *events* become more frequent.

Hunting Experiences as *Events* with Ecological and Social Variables in the *Model Structure*:

Hunting experiences can be thought of as events that mark interactions between ecological and social factors (e.g., between ducks and hunters), or among social factors (e.g., among hunters, or between hunters and non-hunters). For example, one of the most important events for duck hunters – the experience of "seeing ducks" – requires (a) ducks, and (b) duck hunters to be in the same place at the same time. The frequency (i.e., how many times hunters see ducks in a day of hunting) and magnitude (i.e., how many ducks are seen per experience) of this kind of event depends on changes in numbers of ducks and numbers of hunters over time.

As a starting point for exploring how hunting experiences could be affected in different ways by changes in season dates, we tie results from Part I above to numbers of ducks and hunters occurring in an area. We focus particularly on seeing and harvesting ducks as events because these have been documented to affect hunter satisfaction (Enck and Decker 1990, Ringleman 1997). Our intent is to improve Task Force Members' understanding of how season dates might influence hunting experiences, and ultimately hunters' satisfaction with their duck-hunting experiences, by reducing the complexity associated with these relationships.

Because workshop participants generated many possible interpretations of the broad reasons underlying preferences for season dates, one might logically assume that complexity of the model structure would be increased rather than reduced. However, putting a conceptual model "on paper" provides a tool for assessing whether all of the possible interpretations can be similarly important or even plausible. Further, this assessment can improve understanding about what the important components of model structure might be, how the components or variables change in relation to one another (i.e., what the model behavior is), and how hunters' experiences (i.e., events) could vary in response to changes in season dates.

Developing a conceptual model like the one described in this section requires an iterative process (Morecraft and Sterman 1994, Richardson and Andersen 1995, Ford 1999). Usually, as one works through the process, new information is gained that changes one's ideas about what has been done before. In this particular case, lack of time at the workshop precluded us from going through the iterative process. Therefore, the model produced below is the authors' attempt to synthesize the thinking of workshop participants based on the discussion that occurred. **We fully expect that Task Force members and other decision makers would add to, change, or otherwise improve upon the conceptual model to enhance its use for decision making.**

How to start developing the model? Successfully depicting a conceptual model and using it for making decisions about season dates requires completion of the following preliminary tasks: (1) defining the management problem and purpose of the conceptual model, (2) identifying and defining important variables, (3) describing reference modes showing how those variables typically change or "behave" over time in the absence of other variables, (4) evaluating assumed relationships between variables, (5) developing dynamic hypotheses about the model structure necessary to produce the model "behavior" described in #4 (Siemer and Otto 2005). Below, we accomplish steps 1-5. Some decisions also necessitate simulating the model to empirically test different policy or management options. In this case, simulation would require substantially more effort than is needed to assist in decision-making by Task Force members.

Key questions to be addressed in step 1:

- **How many kinds of hunter satisfaction exist in the context of season dates?**
- **To which kind of hunter satisfaction is future participation in hunting tied?**
- **Is the management "problem" to maintain hunters' satisfaction with the process used to set season dates, or to set season dates that maintain hunters' satisfaction with their duck-hunting experiences?**
- **Is the purpose of the conceptual model to predict how satisfied hunters will be with particular season dates, or to help Task Force members understand better how changing hunting season dates likely would affect important aspects of hunters' experiences?**

1. Defining the management problem (objective) and the purpose of the model. First, some background. Duck hunting participation generally has been declining in the U.S. for the last decade, and the situation in New York State is similar to the national picture (USFWS duck stamp sale data). This decline is a concern of management agencies because most of the financial and political support for conservation of duck populations and their habitats comes from active hunters (Johnson and Case 2000). Many in the waterfowl management community believe that participation by duck hunters is tied to their level of duck-hunting satisfaction. Yet, to date, no metric of hunter satisfaction is formally considered as a management objective, either at the state or federal level (Enck and Ringelman 2006).

One reason for this is that few empirical data exist to understand how hunter satisfaction is related to harvest regulations (Ringelman 1997). Moreover, hunter satisfaction has not been monitored regularly or consistently, and thus no way exists to evaluate whether the federal framework of duck-hunting regulations (i.e., bag limit, season length) improve or detract from hunter satisfaction. Finally, flyways and states implement the federal framework by choosing specific season dates, splits, zones, and species/sex-specific regulations, all of which affect hunter satisfaction in unknown ways. Given that background, maintaining a specified level of duck hunter satisfaction is an unstated, but vitally important, fundamental objective of DEC. Even unstated, hunter satisfaction is the focus of management decisions in New York.

Any management decision, including, in this case, identification of season dates, is directed at addressing some management problem (i.e., achieving a management objective). Thus, the management problem pertains directly to the task of the Task Forces. A tool often used in group model-building exercises for focusing attention on the management problem (Ford 1999) is to develop a graph showing what decision-makers know about historic trends in the problem to be managed, as well as their desired-future and feared-future conditions with respect to the problem. Given the importance of hunter satisfaction in statement of the management problem, we developed a graph of what DEC waterfowl biologists know about hunter satisfaction with season dates (Figure 1).

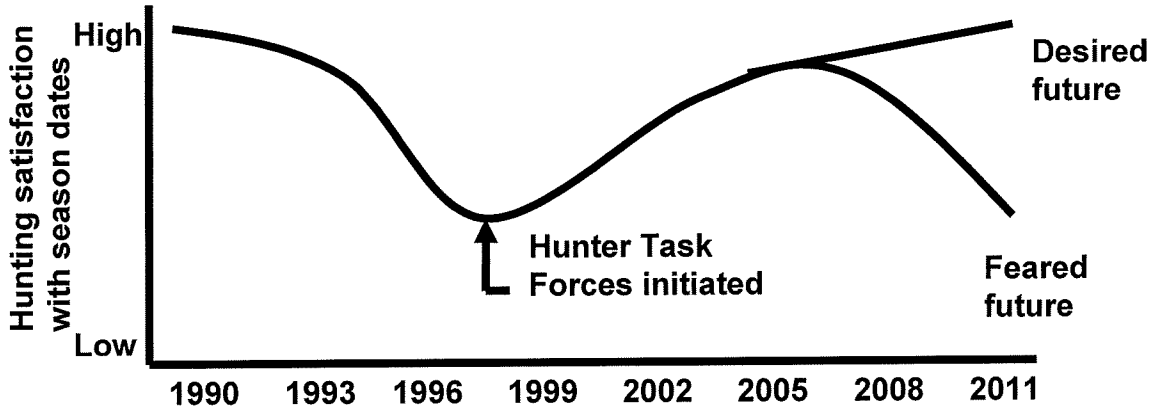


Figure 1. Graphical description of the management problem: what season dates should be recommended for duck hunting to maintain high levels of duck hunter satisfaction?

In the early 1990s, duck-hunter satisfaction apparently decreased, resulting in complaints to DEC. In response, DEC initiated duck hunter Task Forces to recommend season dates (starting in 1997 for the Western Zone, later for other zones). Direct involvement by duck-hunting groups and individuals, some of whom had lodged complaints, and increased transparency in the process apparently restored satisfaction to higher levels, resulting in fewer complaints to DEC. The desired future condition is to maintain those restored levels, but the feared future condition is that satisfaction will decrease again without a better understanding of how the timing of the duck season affects hunter satisfaction.

Hunting satisfaction – three kinds, but only one relates directly to season dates

Researchers studying duck hunting satisfaction (e.g., Vaske et al. 1986, Ringleman 1997, Enck et al. 2004) differentiate among three kinds: (1) **decision process satisfaction**, (2) **decision outcome satisfaction**, and (3) **hunting experience satisfaction**.

Decision process satisfaction pertains, in this case, to the process of how season dates are determined, regardless of the dates selected. Decision outcome satisfaction has to do with hunters' attitudes about the particular season dates selected, regardless of the process used to make the decision. Hunting experience satisfaction is an evaluation of the events that occur while hunting during the open season.

(continued in side-bar on next page)

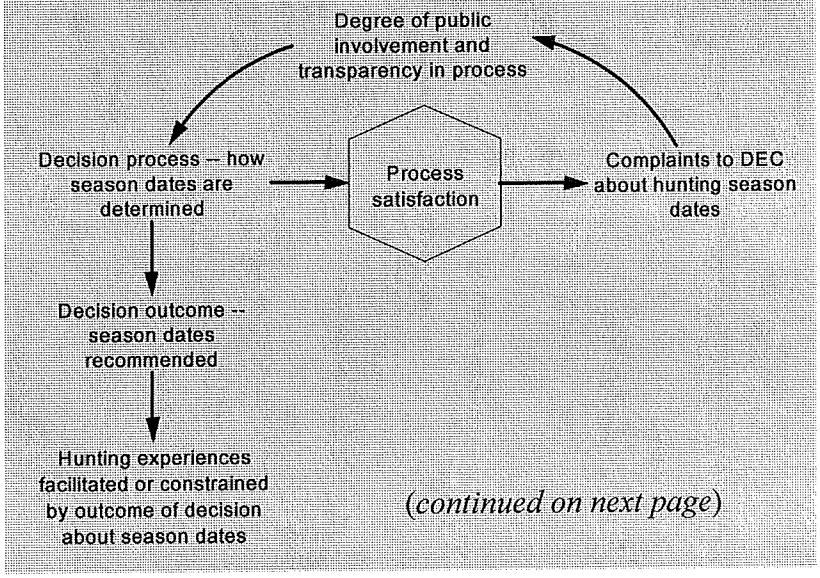
As defined in the side-bar to the left, three related, but different, kinds of satisfaction exist with respect to season dates. It should be noted that we have no specific data for any of these kinds of satisfaction. The trend in satisfaction shown in Figure 1 above is an index to the aggregation of all three kinds of satisfaction. The rebound in satisfaction shown in the figure reflects the increased transparency and public involvement resulting from DEC's implementation of Hunter Task Forces, as noted under decision process satisfaction in the sidebar below.

Of great importance with respect to developing a conceptual model that can be used by the Task Forces to make the best possible recommendations about season dates is that **the three kinds of hunter satisfaction are <u>not</u> equally important in terms of either continued participation by duck hunters (i.e., hunter retention) or as a focus of decisions by the Task Forces.**

First, <u>decision process satisfaction</u> was addressed by DEC by implementing the Task Forces, and none of the decisions by Task Forces pertain directly to process satisfaction. Note that the loop in the diagram at right reflects the reality that complaints to DEC about season dates first led to increasing degree of public involvement in the decision-making process, and that that eventually led to a decrease in complaints.

Also, given that current Task Force members exclusively are "more-avid" duck hunters who participate consistently year-to-year and, on average, for more days than most other duck hunters, any of their previous complaints to DEC about the season-setting process would not be a good index to future participation by hunters in the general population of duck hunters. Rather, these complaints are simply an index to how satisfied the "more-avid" duck hunters are with the process used to determine season dates for duck hunting.

Decision process satisfaction is affected by the degree of transparency and public involvement incorporated in making the decision as depicted below. Hunters who perceive they have a large stake in the timing of the season may be dissatisfied with the process (regardless of the dates selected), unless they have an explicit chance to give input. However, decision process satisfaction (in center) does not depend on the season dates selected. Thus, there exists no conceptual link between process satisfaction and stated reasons underlying hunters' preferences for season dates.



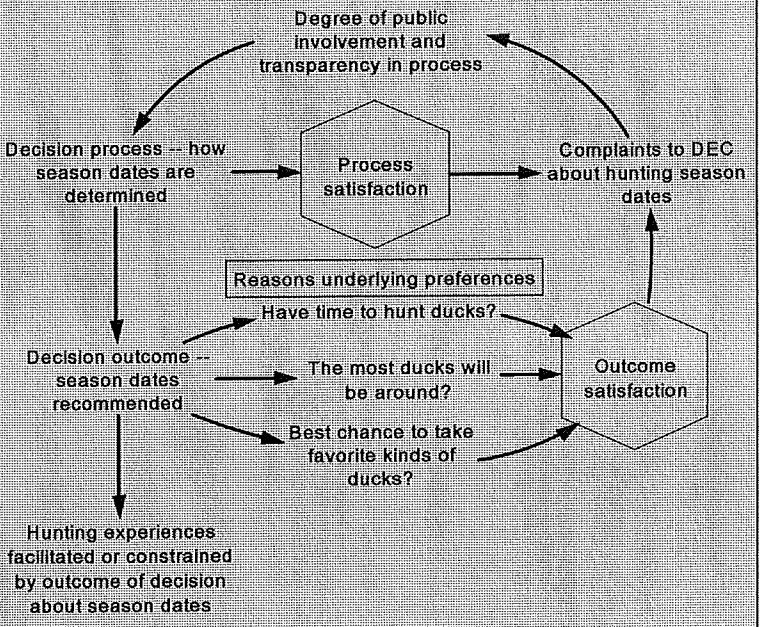
(continued on next page)

Second, decision outcome satisfaction (side-bar at right, top figure) hypothetically could affect continued participation by duck hunters. Hunters probably evaluate published season dates based on they prefer particular dates (are the published seasons consistent with dates when the hunters have time to go duck hunting, when they think the most ducks will be around, etc.). However, no research exists to indicate that people choose not to go duck hunting because they do not like the season dates.

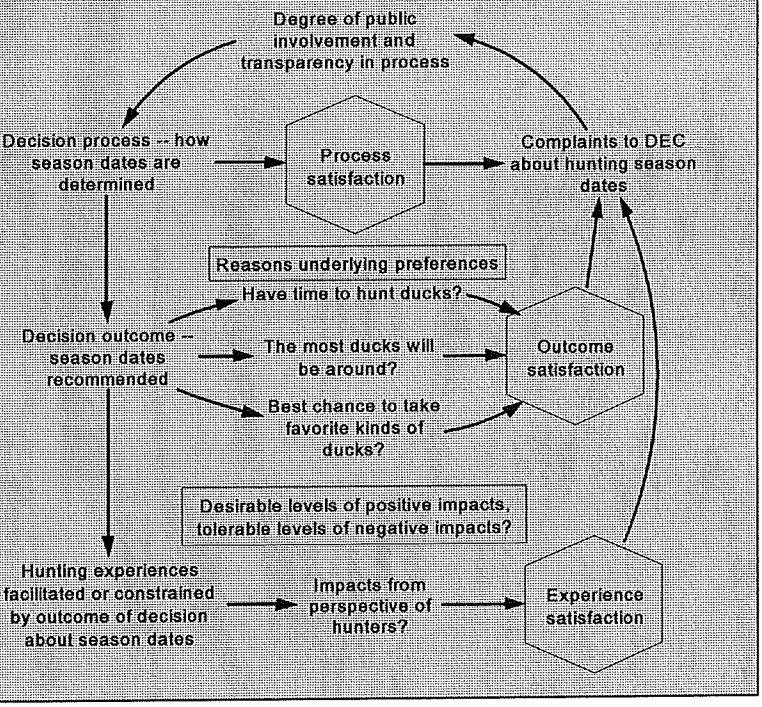
Experience satisfaction (side-bar at right, lower figure) is the only kind influenced entirely by events (i.e., hunting experiences) that occur as a result of hunters actually hunting during the dates recommended by Task Forces and approved by DEC. Therefore, **experience satisfaction is a direct assessment of whether hunters have experienced the kinds of events they associate with the reasons why they prefer particular season dates**. At this time, no data exist about extant levels of experience satisfaction for duck hunters in New York – in part because specific experiences and associated forms of data to collect have not yet been identified.

Readers should be aware that the set of words and arrows (i.e., model structure) revealed in the side-bars is not the model that will be useful to Task Force members for making the best

Decision outcome satisfaction is linked to season dates as shown below. Before going hunting, hunters evaluate dates based on reasons for their preferences (un-shaded part).



Hunting experience satisfaction is an evaluation of the positive and negative aspects of duck hunting during the open season (un-shaded part below). Did actually hunting when: (1) the most ducks were around, (2) best chance of taking favorite kinds of ducks existed, and (3) the weather was best for duck hunting result in satisfying experiences?



recommendations about season dates. The side-bars do portray a conceptual model. However, that model shows relationships between the three kinds of hunting satisfaction and how those satisfactions "feedback" on the decision-making process as well as on the decision outcome (i.e., season dates recommended). The conceptual model to be used by duck hunter Task Forces will focus specifically on the "hunting experiences facilitated or constrained by season dates" shown at the bottom-left of the model loop in the side-bar. We develop that model in subsequent sections on the following pages.

Based on the assertion that decisions made by Task Forces about season dates have the greatest affect on experience satisfaction, we restate the management problem here (Figure 2).

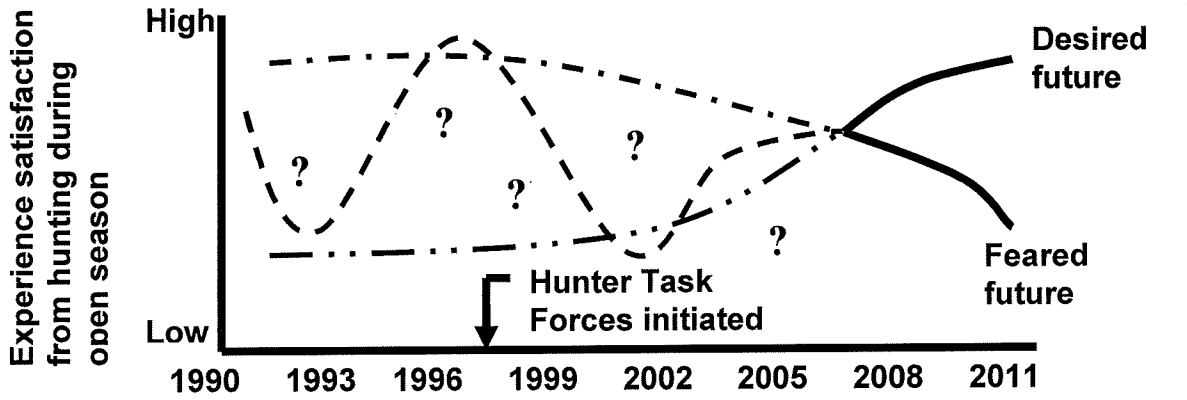


Figure 2. Revised depiction of the "management problem" in terms of experience satisfaction of duck hunters when they go hunting during season dates recommended by Task Forces and approved by DEC.

Key points made in step 1:

- **Future hunting participation is tied more strongly to experience satisfaction than to either decision process satisfaction or decision outcome satisfaction**
- **The management "problem" is for Hunter Task Forces to recommend seasons for duck hunting in each zone that are consistent with hunters' preferences, in that they lead to satisfying experiences on which those preferences are based.**
- **In other words, the fundamental management objective being addressed by the Task Forces is to maintain sufficiently high levels of experience satisfaction for duck hunters.**
- **Based on the management problem described above, the purpose of the conceptual model is to produce a tool for helping Task Forces to understand better how changing hunting season dates likely would affect important aspects of hunters' experiences.**

Key question to be addressed in step 2:

- **What kinds of variables should be included in the conceptual model?**

2. Identifying model variables. Variable identification requires first determining model time frame (i.e., temporal boundary), hunting experiences or events to be depicted (conceptual boundary), and how variables associated with one event may "cause" or "inhibit" another event (causal boundary). The temporal boundary is October - January, which is when duck seasons can occur based on federal guidelines. The conceptual boundary includes ecological (i.e., regarding ducks) and social components (i.e., regarding hunters) and their interactions (i.e., hunting experiences as events) likely to be affected by season dates. Other large-scale factors like size of continental duck population, harvest of ducks outside the state, and even season length and bag limit are beyond the scope of this model. Finally, causal boundary will include feedback loops described in more detail in a later section on dynamic hypotheses.

Ecological variables

number of ducks in area – total number of ducks in the general area (e.g., Zone)

in-migration – addition of ducks from other places

out-migration – subtraction of ducks migrating out of area

Social variables

licensed duck hunters – total number of people with a duck stamp and HIP number

active duck hunters – number of licensed hunters actually hunting on a given day

intentions to hunt ducks – likelihood that licensed hunters will go afield, affected by reasons underlying preferences for season dates and satisfaction with hunting experiences

Ecological-social interactions in the form of hunting experiences or events

hunters seeing ducks – total number of sightings per hunter per day (where each sighting is an event); not total number of ducks seen

hunters shooting at ducks – number of shooting events per hunter per day, not total shots fired

hunters harvesting ducks – initially, this pertains to number of harvesting events per hunter per day; number of harvesting events involving "favorite kinds of ducks" also may be important

Key point made in step 2:

- **Variables identified in this step pertain only to model structure for events most likely to affect *experience satisfaction* – based on previous research.**

Key questions to be addressed in step 3:

- **How much, and what kinds of data do you need to develop a reference mode for a variable?**
- **What kinds of reference modes do Task Force members already use in their discussions?**
- **Where else can data come from to develop reference modes for key variables?**

3. Describing reference modes to show variable behavior over time. A reference mode is a verbal or graphic description of how a particular variable typically changes over a defined time period – in the absence of interactions with other variables. Here, "time" should be clearly defined for each variable in relation to the temporal boundary on the management "problem" and its potential "solutions" (i.e., decision outcomes). Some variables may change substantially from week-to-week whereas other "variables" might be constant during October through January.

We describe reference modes only for ecological and social variables. We do not describe reference modes for interaction variables (e.g., seeing ducks, harvesting ducks) or for experience satisfaction because, by definition, these vary in relation to other variables in the model. **These reference modes reflect the authors' assumptions, and should be revised in future discussions by Hunter Task Force members.**

Ecological variables

number of ducks in area – depends on zone and general habitat type. However, in the absence of an open season, relative numbers of ducks in Western, Northeastern, and Southeastern zones may be relatively high in early October, increasing even more to a peak in early to mid November because of in-migration, and then decreasing for the remainder of the time period due to out-migration and harvest.

in-migration – overall, low in early October, increasing rapidly during the month to peak in early November, then decreasing to a trickle by early December. Some differences from this general pattern by Zone, particularly for Long Island.

out-migration – overall, fairly low from early October until mid November, when it increases substantially. Again, some differences by Zone.

Social variables

licensed duck hunters – ~33,000 people obtain a duck stamp and HIP number annually.

active duck hunters – absolute number is unknown, but relative number hunting on a given day in each management zone may vary according to the patterns depicted for season date preferences in Enck et al. (2006a).

intentions to hunt ducks – vary on any given day from high to low similar to the patterns depicted for season date preferences in Enck et al. (2006a).

Key points made in step 3:

- **Reference modes can be general in nature and do not require high degrees of specificity – usually it is the general shape of the graph that matters most.**
- **Task Force members already use in their discussions unwritten reference modes for numbers of ducks in the area, and patterns of in-migration and out-migration.**
- **DEC collects data annually (through automated licensing system) that can be used to create a reference mode of the total number of licensed duck hunters in any given year.**
- **Graphs of season date preferences from the 2005 statewide duck hunter survey provide reasonable reference modes pertaining to hunters' intentions to go duck hunting.**

Key questions to be addressed in step 4:

- **What assumptions exist about how different variables relate to each other?**
- **How valid are those assumptions, and how would you know?**
- **Which reflects greater complexity about "how the world works" – linear connections with many exogenous factors, or dynamic feedback systems among endogenous factors?**
- **Which reflects greater learning opportunity for decision makers – linear connections with many exogenous factors, or dynamic feedback systems among endogenous factors?**

4. Evaluating assumed relationships between variables. All of us make assumptions that lead to "fuzzy thinking" about solutions to problems. Those assumptions need to be stated, evaluated, and either verified or changed to ensure that our thinking (i.e., conceptual models) can explain historical patterns in the model behavior of interest (Ford 1999). For example, what model structure is necessary to explain the variations in the number of ducks and the number of active hunters over the 4-month period of the hunting season (i.e., October through January)? Answering this question provides a "reality-check" about causal factors in the model, and helps identify the kinds of data that are most useful for decision making.

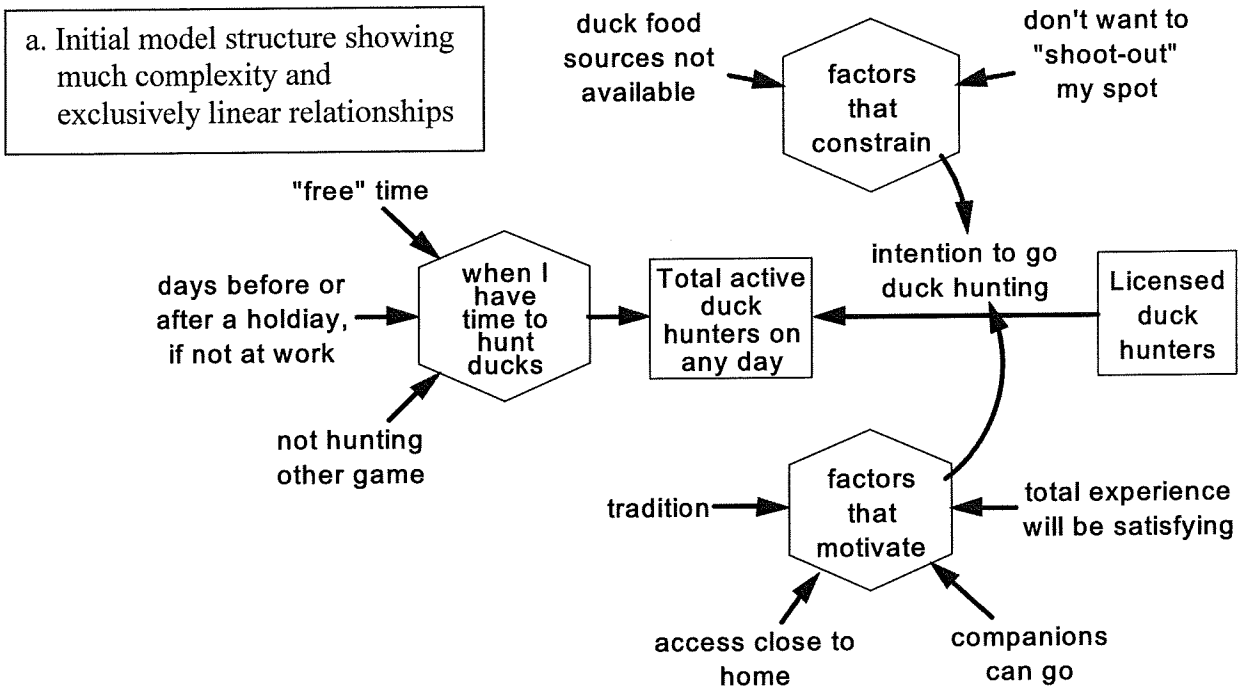
This "reality-check" is accomplished by describing assumptions that emerged from the workshop discussion about different interpretations of reasons underlying hunters' preferences for season dates. Assumptions are described in terms of the structure of a conceptual model. Then, we evaluate the plausibility of that structure and present a revised model based on the evaluation. The revised model shows structure necessary to reproduce the reference mode patterns described in step 3 above. Highlighted words in the paragraphs below are components of model structure explicitly included in the figures.

Hunter Sector

We begin with an initial model of a Hunter Sector to reflect the numbers of hunters actively hunting ducks. Our description is based on workshop participants' interpretations of "when I have time to hunt" (see page 2) and a follow-up discussion about factors influencing hunters' intentions to go duck hunting (see page 3). Participants acknowledged that **licensed duck hunters** become **active duck hunters** by acting on their **intentions to hunt** ducks on any given day (Figure 3a). Possible model structure affecting hunters' intentions included both **factors that constrain** and **factors that motivate** hunters. By definition, **"when I have time to hunt"** is a constraint on the total number of active hunters.

The workshop discussion revealed that participants think about the various interpretations of **time to hunt** and factors affecting hunters' **intentions to hunt** as being external influences on the number of hunters afield on any given day. An external influence means that arrows lead *from* these factors *to* **total number of active duck hunters** in the model, but no arrows *feed-back* into these factors from other variables in the model. Thus, these factors do not vary in relation to anything else in the model. Considering these factors as being external to the model reduces their value for understanding changes in hunter numbers. Greatest understanding about hunter behaviors and resulting levels of satisfaction will be generated by improved knowledge of relationships among internal, not external, factors (Ford 1999:97).

Also, when **free time** occurs, which is one of the possible interpretations of **time to hunt** listed by participants, likely would vary considerably among hunters. Thus, we assume this time constraint would "average out" over the hunting season, resulting in no discernable pattern in the number of hunters afield on any given day. Another possible interpretation, whether licensed duck hunters are **not hunting other game**, generally is not important according to the statewide survey (Enck et al. 2006a). The only interpretation identified by participants that likely would influence hunting intentions in a measurable way is that some duck hunters could have more of a chance to **hunt on the days before or after a major holiday** (i.e., Thanksgiving, Christmas).



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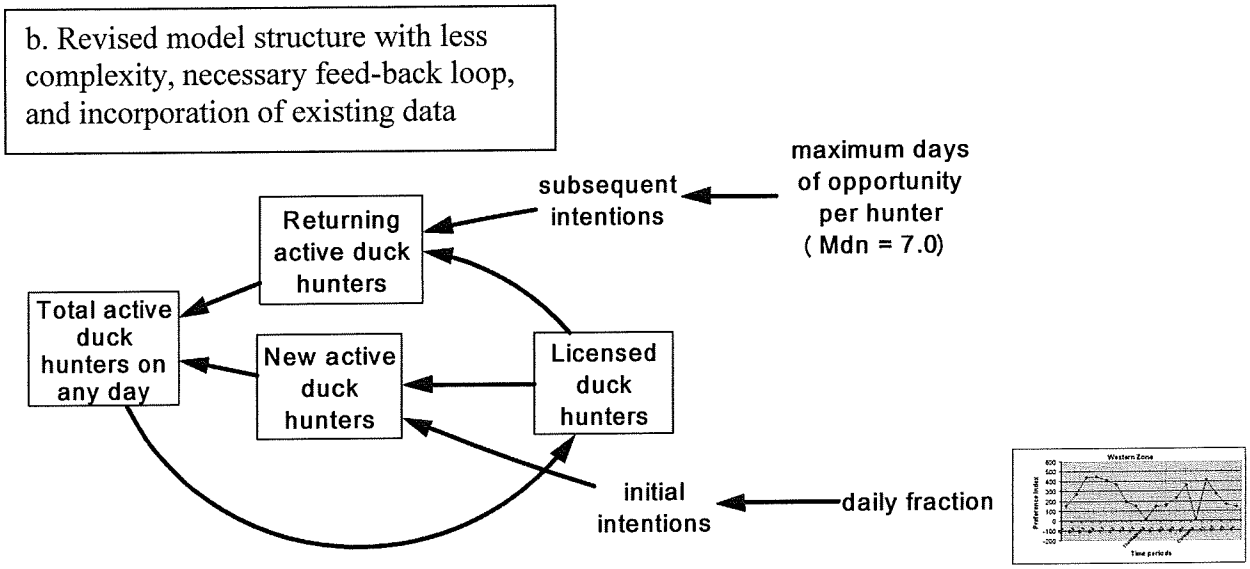


Figure 3. Initial (a) and revised (b) conceptual models incorporating "when I have time to hunt" as a reason underlying duck hunters' preferences for season dates, showing effects of possible interpretations of this reason on duck hunters' intentions to go hunting.

Availability of hunting companions could be important for hunters with an affiliative motivation for hunting (Enck et al. 1993), but hunters still would have to have "**time to hunt.**" Similarly, both **access close to home** and temporal expectations about **when the experience will be most satisfying** (i.e., in terms of scenic beauty, other wildlife encountered, etc.) will vary among hunters. Such variation would mask any noticeable effect on numbers of hunters over the course of a hunting season. Few hunters are likely to know about duck availability in relation to changes in **local food sources**, making that factor unimportant for decisions about season dates. Finally, whereas the timing of in-migration could affect the relative number of hunters if migration could be predicted, very few hunters are likely to think of ducks as "their flocks" which can be managed on a local level (i.e., **not wanting to "shoot-out" my spot**).

A revised structure for the hunter sector (Figure 3b) also shows that patterns of hunter participation necessarily vary in relation to hunters' intentions to go duck hunting. More specifically, some proportion of **licensed duck hunters** acts on their **initial intentions to hunt** ducks on any given day and become **new active duck hunters**. As mentioned previously (see page 17), the number of active duck hunters afield on any given day generally should reflect the patterns shown in graphs of season date preferences (Enck et al. 2006a), in the absence of any major variations in hunters' intentions to hunt ducks. The arrow at the bottom of the revised structure – going from **total active duck hunters** back to **licensed duck hunters** accounts for a return in hunters' status from active to licensed (i.e., the pool of potential duck hunters) at the end of a day of hunting -- until they act on their intentions to hunt ducks on some subsequent day. Hunters' acting on their **subsequent intentions** are **returning active duck hunters**.

The revised structure in Figure 3b incorporates some variables as external influences similar to Figure 3a. However, the revised model differentiates whether these external influences affect **initial intentions** vs. **subsequent intentions** to hunt ducks. Also, note that the possibility that many duck hunters could have more of a chance to hunt the day before or after a major holiday (i.e., Thanksgiving, Christmas) is accounted for as the proportion (i.e., **daily fraction**) of **licensed duck hunters** who act on their intentions to hunt and become **active duck hunters** on any given day. This daily fraction likely will follow a pattern similar to that reflected in the graphs for season date preferences showing low preference for hunting on major holidays but higher preference on days immediately before and after holidays.

The revised model also explicitly acknowledges that hunters' subsequent intentions are constrained by some **maximum opportunity to hunt**. This maximum certainly is less than the 60-day length of recent duck seasons, and can be conservatively indicated by the median number of days hunted (~7) by duck hunters in recent years (Enck et al. 2006a). Further note that maximum opportunity does not increase or decrease subsequent intentions. Rather, it operates as a cap on subsequent intentions.

To provide further support that the revised model for the hunter sector is an improvement over the initial model, consider the kinds of data that would be needed to aid decision-making with the two models (Table 1). In either case, decision-making would benefit from, or even require, scientifically valid data. However, the kind data that would be needed differ substantially between models. Further, as noted previously, many of the variables in the initial model differ from hunter-to-hunter without useful patterns for explaining participation by duck

hunters. Finally, under the column "other data" in Table 1 are two variables pertaining to the weighting of very qualitative factors. The qualitative factors themselves would be very hard to ascertain and the notion of weighting them would be very subjective. These challenges are eliminated in the revised model. The number of variables in the revised model also is substantially reduced, and the ones included are much more concrete and measurable.

Table 1. Types of ecological and social science data needed for decision making under the initial vs. revised hunter sector models pertaining to "when I have time to hunt ducks."

Model	Ecological data	Social data	Other data
Initial	availability of duck food sources close to hunting areas	number of licensed duck hunters	dates of holidays
		when does "free time" usually occur?	dates of hunting seasons for other game animals
		amount of desire to "not shoot-out" hunting area	availability of access for duck hunting
		perception of "when duck hunting will be most satisfying"	relative weight of constraining vs. motivating factors on intentions to hunt
		availability of hunting companions	relative weight of intending to hunt vs. having time to hunt ducks
		when do duck hunters traditionally hunt ducks?	
Revised	none in this part of the model	number of licensed duck hunters	none in this part of the model
		daily fraction of licensed hunters intending to hunt initially (i.e., first time this season) on a given day, based on preference curves from the survey data	
		maximum days hunters usually can hunt, on average, as a constraint subsequent intentions to hunt again	

Summary of changes between the initial and revised Hunter Sector models.

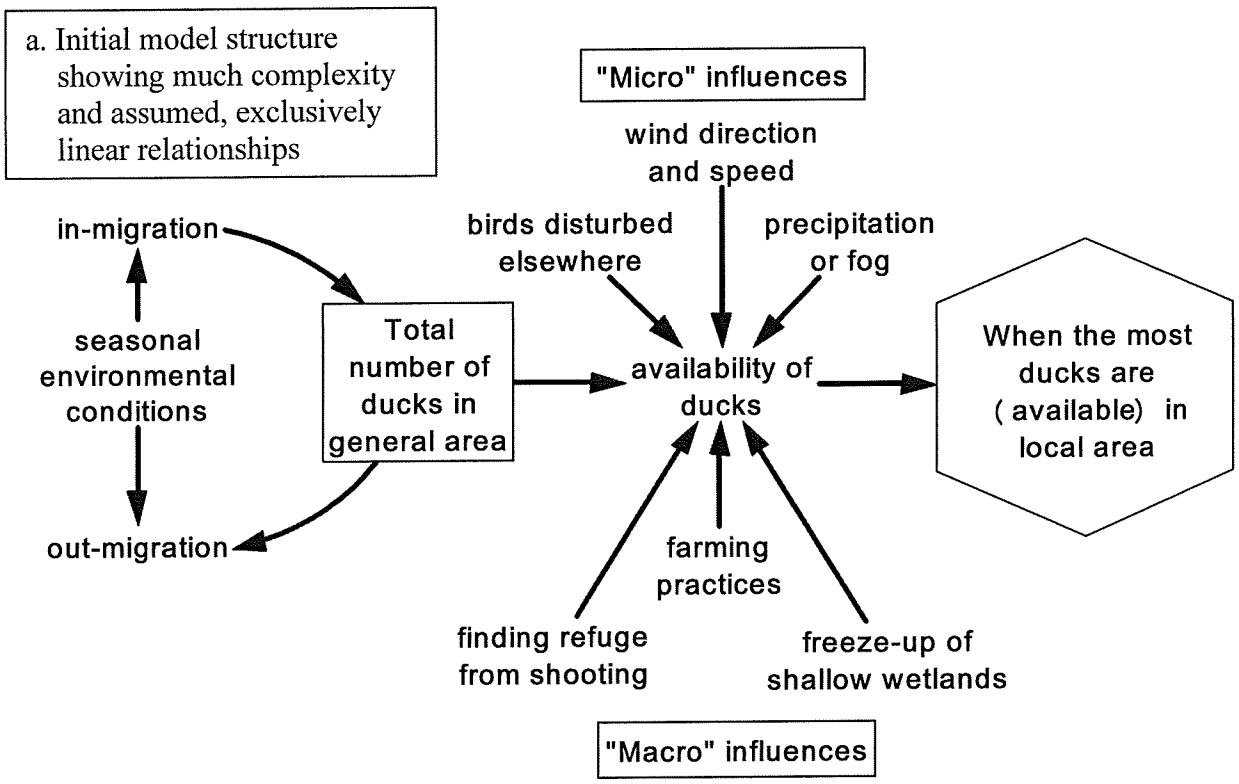
- **"Time to hunt" is eliminated as an explicit variable, but its various interpretations are accounted for in the "daily fraction" (for initial intentions) and "maximum days of opportunity" (for subsequent intentions).**
- **The overwhelming complexity of possible constraining or motivating influences on intentions to hunt ducks is simplified dramatically by using "daily fractions" and "maximum days of opportunity" – both of which can be measured.**
- **The revised model depicts the dynamic nature of hunting participation (both on a day-to-day basis, and over the course of the hunting season) whereas the initial model structure contains no dynamic feedback.**
- **The revised model incorporates data from recent research as a reference mode for day-to-day participation.**

Duck Sector

Our depiction of workshop participants' assumptions about model structure for the duck sector is based on their interpretations of "when the most ducks are around" (see page 3). All agreed that breeding ducks occur in the general area (e.g., zone or county), and that those are increased by **in-migration** from other areas and decreased by **out-migration** of ducks (Figure 4a). Many also believed that "most ducks" refers to **ducks available to hunters** in the habitats and local spots those hunters primarily hunt. Participants identified several possible **"macro" influences** on duck distribution across the landscape (i.e., refugia where ducks are undisturbed, farming practices affecting upland feeding locations, and freeze-out of shallow wetlands hunted by most hunters), and which sometimes make **ducks unavailable to hunters**. In addition, several **"micro" influences** (i.e., daily weather conditions and disturbance of ducks elsewhere) were identified and believed to affect availability of ducks more locally.

A revised structure for the duck sector (Figure 4b) reduces the number of variables depending on whether they vary in measurable ways. For example, **total number of ducks** in the area varies from October-January due to **in-migration** and **out-migration**, and to a lesser extent, **harvest**. As noted previously (see page 17), Task Force members already have a relative sense of total duck abundance due to the influence of migration, which largely is affected by seasonal environmental conditions – which relates to another major reason underlying hunters' preferences for season dates, "when the weather is best for duck hunting."

"Best weather" for hunting can be summarized as: some like it hot, and some like it cold. According to Enck et al. (2006a), those hunting primarily in shallow-water habitats tend to prefer earlier season opportunities. Conversely, hunters who hunt primarily in deep- or salt-water habitats that are slower to freeze tend to prefer later season opportunities. The connection between habitats hunted and timing of freeze-out suggests that average daily temperature is an important index to **seasonal environmental conditions**.



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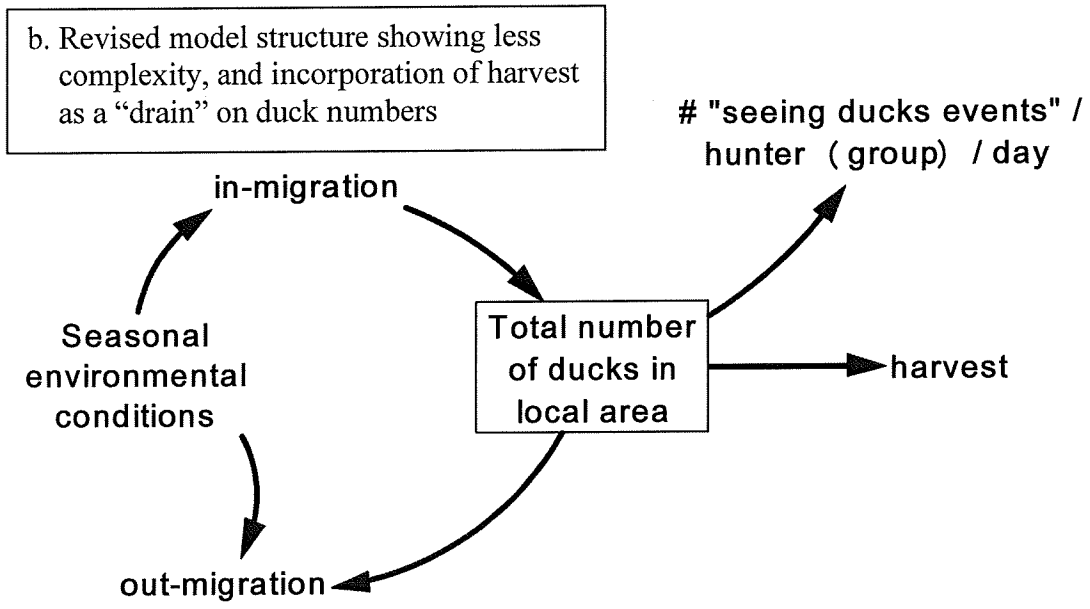


Figure 4. Comparison of initial (a) and revised (b) conceptual models incorporating "when the most ducks are around" as a reason underlying duck hunters' preferences for season dates.

Another important aspect of seasonal conditions is day length as an index to locally produced dabblers out-migrating. Day length decreases similarly in all management zones during the fall period. Average daily temperature differs by zone because of the influence of elevation and large bodies of water. Data for different areas in the state can be accessed at http://www.ncdc.noaa.gov/oa/mpp/freedata.html (National Climate Data Center 2007).

Consideration of kinds of variables needed for decision-making under the initial and revised models for the duck sector reveals several improvements (Table 2). The number of variables is reduced. Variables included in the model vary in predictable and measurable patterns. Further, workshop participants believed that hunters they represent already think about these patterns to develop their preferences for season dates, and to express their intentions to go hunting "when the most ducks are around." Task Force members also discussed how they personally use knowledge of these patterns when recommending season dates.

Table 2. Types of ecological and social science data needed for decision making under the initial vs. revised hunter sector models pertaining to "when the most ducks are around" and "when the weather is best for hunting ducks."

Model	Ecological data	Social data	Other data
Initial	number of ducks breeding in local area	farmers' intentions to grow crops that might be food sources for ducks in area	predicted daily weather conditions
	number of ducks migrating into the area over the fall	timing of when farmers harvest crops that might be food for ducks in area	average timing of "freeze-up" in the area
	number of ducks migrating out of the area over the fall		availability of un-hunted refugia in the area
	timing of environmental cues for migration		
Revised	relative number of ducks ducks in local area	none in this part of the model	none in this part of the model
	relative number of ducks in-migrating during fall		
	relative number of ducks out-migrating during fall		
	environmental cues for in- and out-migration		

Summary of changes between the initial and revised Duck Sector models.

- **We reduced complexity greatly in the revised model by including only those components that vary according to some pattern.**
- **Rather than trying to model the unknowable number of ducks available in local areas, the focus of the revised model is to reflect the known reference mode behavior for ducks in the general area because the number of ducks available in local areas is the basis for hunters' experiences which are more appropriately described under dynamic hypotheses in the next section.**
- **Task Force members already rely on knowledge of this pattern of model behavior when recommending season dates, and the difference between the total number of ducks in the general area and the number of ducks available to hunters is better reflected in terms of dynamic relationships between ducks and hunters (described in the next section).**

Hunter-Duck Interaction Sector

Note in the last figure (Figure 4b) the "flow" from the variable **total number of ducks in local area** to the variable **harvest**. The currency or units of this "flow" is **number of ducks harvested per hunter per day**. Thus, this flow provides the necessary link between the Hunter Sector described earlier and the Duck Sector. More specifically, this link between sectors involves a series of hunting events, occurring as a result of interactions between the duck and hunter sectors (Figure 5).

The number of these events generally will vary in relation to either the number of ducks in the area or the number of active hunters afield. If more ducks occur in the area (e.g., due to in-migration), more events will occur, including harvest. If more hunters go afield (e.g., opening day phenomenon or other popular hunting days), more events will occur, also including harvest. In either case, the "flow" of harvesting will increase, and fewer ducks will exist in the area (all other things being equal). In reality, both duck numbers and hunter numbers will vary at the same time in somewhat predictable, but different, ways. Duck numbers will change mostly in relation to migration. Active hunter numbers will vary in relation to preference curves. Thus, the number of events occurring also will vary over time. Note that for all the events shown in the model, the "units" are the average number per hunter per day, which has implications for the kind of data needed to think about the mode (Table 3).

Some of the "seeing ducks events" will involve ducks too far away for shots to be taken, but some of these events will involve ducks that are in-range. At this point in the development of the model, the proportion of "seeing ducks events" that are in-range is not particularly important – only that some proportion of the "seeing ducks events" will be opportunities for "**shooting at ducks** events." Finally, to close the feedback loop, some (probably most) of the

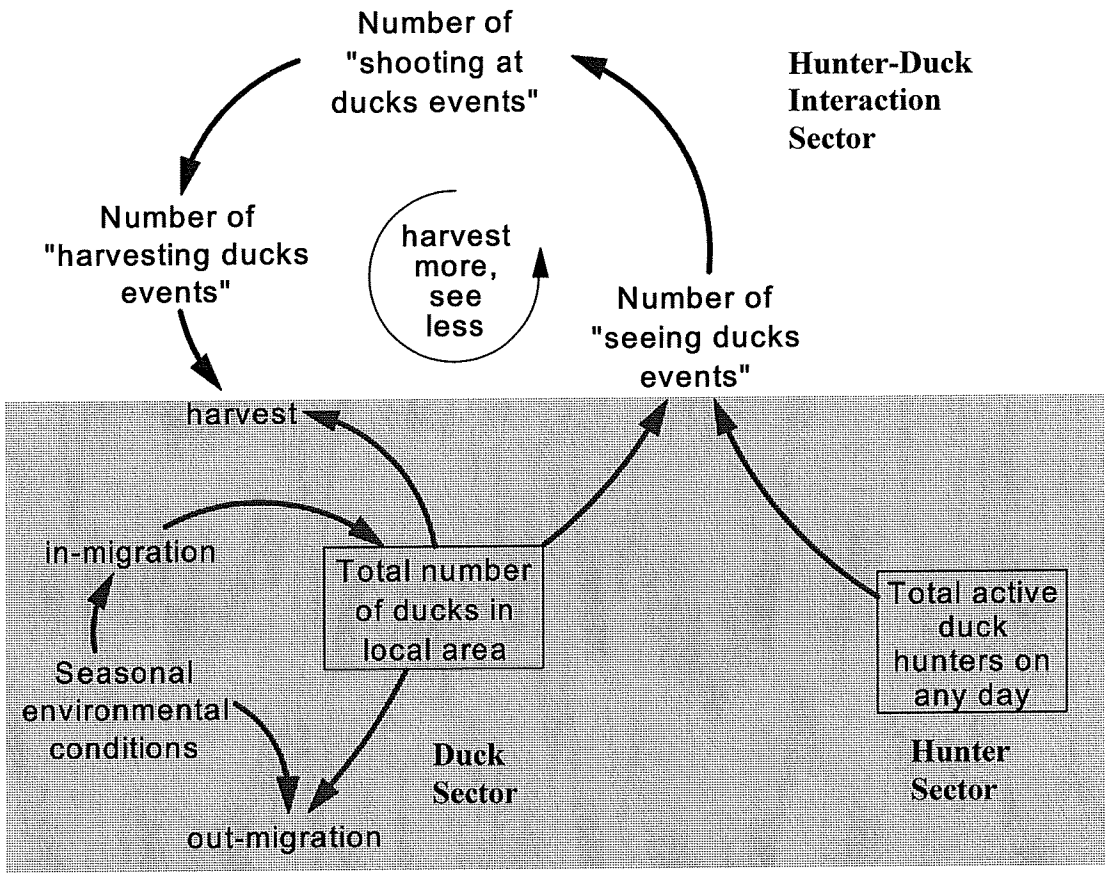


Figure 5. Interactions between Duck Sector and Hunter Sector lead to a series of hunting events (seeing ducks, shooting at ducks, harvesting ducks), that feed-back on and decrease the total number of ducks in the area. Shaded parts were described in previous figures.

"shooting at ducks events" will lead to "harvesting ducks events." To clarify, these are hunting experiences in which ducks are harvested – not the number of ducks taken. The total number of harvested ducks depends on the frequency (or rate) of shooting events as well as the average number of ducks shot during each harvesting ducks event. The number of ducks harvested then decreases the total number of ducks in the area, by way of the three connected events: seeing ducks, shooting at ducks, and harvesting ducks.

Table 3. Types of ecological and social science data needed for understanding how hunter-duck "events" provide a linkage between the hunter sector and the duck sector of the conceptual model.

Model	Ecological data	Social data	Other data
Hunter-Duck Interaction Sector	none in this part of model	average number of times per day that hunters see ducks while hunting (i.e., have "seeing ducks events") proportion of "seeing ducks events" that result in "shooting ducks events" proportion of "shooting ducks events" that result in "harvesting ducks events" average number of ducks taken during each "harvesting ducks event"	none in this part of model

Key Points from the Hunter-Duck Sector:

- **The series of "events" in this sector accounts for the differentiation that workshop participants made between total ducks in area and ducks available to hunters.**
- **Available ducks were defined by participants as those ducks at which hunters have a reasonable chance of getting shots. Participants noted that not all ducks in the area will be seen, and some that are seen will be too distant to be available to hunters.**
- **Thus, in the model, available ducks are accounted for by the combination of seeing ducks events and shooting at ducks events. Further note that neither of these variables requires a count of the number of ducks involved. Rather, it is the number of events (and not the number of ducks per event) that is important.**

Key questions to be addressed in step 5:

- **When feedback structure occurs in the model, what duck-related impacts do hunters recognize so that the feedback mechanism is "triggered?"**
- **What positive impacts and what negative impacts trigger feedback within the system?**
- **What kinds of data are needed to examine the dynamic hypotheses?**

5. Describing dynamic hypotheses. Dynamic hypotheses are statements about model structure that show feedback relationships within the model (Vennix 1996, Ford 1999). These hypotheses tie together information produced in steps 2-4 above. Like all hypotheses, dynamic hypotheses can be wrong. **The dynamic hypotheses presented below should be evaluated and refined by Task Forces as part of a learning process.**

Theoretically, experience satisfaction *should* reflect the degree to which going hunting "when the most ducks are around" or "when I have the best chance to take my favorite kinds of ducks" leads to the kinds of experiences desired by hunters. Further, experience satisfaction will depend on whether hunters have at least minimum amounts of positive events (e.g., having sufficient sightings to believe they are hunting "when the most ducks are around"), and no more than maximum tolerable amounts of negative events (e.g., believing they are hunting "when I have the least interference from others").

For some kinds of experiences, it may not be the number of events, but rather the quality of those events. Seeing favorite kinds of ducks may be like that in that seeing a flock of a favorite species might be more desirable (and thus more satisfying) than have many "seeing ducks events" with less favorite species. Similarly, perceptions of crowding could result from one particularly severe interaction with other hunters, or from ten less severe interactions.

Development of dynamic hypotheses will improve understanding about which desired hunting experiences (or intolerable one) likely are influenced by changes in season dates. A desired outcome of describing these hypotheses is to consider in a more focused way two of the major reasons underlying hunters' preferences for season dates. These are: "when the most ducks are around" and "when I have the chance to take my favorite kinds of ducks."

a. Dynamic hypotheses about the notion of "when the most ducks are around." Closing the loop from **seeing ducks events** to **harvest** helped build feed-back structure in the model. The necessary existence of that feed-back raises the question of whether feed-back also occurs to the hunter sector. Insights from participants (see page 5 for detailed results) suggest that such feed-back occurs, and that it most likely influences hunters' subsequent intentions to go duck hunting.

Based on this insight, one dynamic hypothesis (Figure 6, depicted as DH1) is that duck hunters go hunting periodically as time allows (i.e., "when I have time to go duck hunting"). As the number of "**seeing ducks events**" they experience increases, their **experience satisfaction** increases. This increase then feeds-back on (and increases) their **subsequent intentions**, increasing the **number of returning active hunters** afield. DH1 reflects workshop participants' beliefs about how the more-avid duck hunters know "when the most ducks are around."

An alternative hypothesis (Figure 6, depicted as DH2) is that many hunters wait to go duck hunting until hearing what other hunters (perhaps more-avid duck hunters) are seeing. If those hunters experience an increase in "**seeing ducks events**" and **communicate** with others about the increase, it feeds-back on **initial intentions** of the vast majority of hunters, leading to an increase in **new active hunters** afield. However, if active hunters report few seeing ducks events, and communicate with others about those dissatisfying experiences, it could inhibit many licensed hunters from initially intending to hunt ducks. DH2 reflects workshop participants' beliefs about how the less-avid duck hunters know "when the most ducks are around."

For completeness, we describe a third alternative. Most hunters may simply expect the Task Forces to recommend season dates that coincide with "when the most ducks are around," and then they can just go duck hunting "when I have time to go duck hunting." In this alternative, there is no feed-back in the model – and thus, no dynamic hypothesis to depict. Rather, hunters' initial and subsequent intentions would be affected by external factors (as in Figure 3a). This "no feed-back alternative" is eliminated for two reasons.

First, the "no feed-back alternative" ignores survey data about reasons underlying preferences for season dates. Second, social science theory suggests some combination of DH1 and DH2 is more likely than the "no feed-back alternative." The Theory of Planned Behavior (Azjen 1991) is a useful foundation for understanding why people engage, again, in hunting (e.g., Rossi and Armstrong 2000). Of particular importance in the theory is that past experience has a substantial influence on one's subsequent intentions. More specifically in the case of duck hunting, one's evaluation of past experience in terms of desirable numbers of positive duck-hunting events and tolerable numbers of negative events influences subsequent intentions.

That duck hunters evaluate their experiences based on the positive and negative impacts associated with those experiences is consistent with the notion of adaptive impact management (AIM), whereby specific stakeholder-identified impacts become the explicit focus of management actions (Riley et al. 2002, Riley et al. 2003, Enck et al. 2006b). Here, DH1 and DH2 explicitly identify "seeing ducks" as a positive impact associated with duck-hunting events. Indeed, previous research (Enck et al. 1993, Ringleman 1997, Enck et al. 2006a, Case 2005) has found that the number of seeing ducks events is a particularly important influence on experience satisfaction, with harvesting ducks a secondary influence. The importance of **seeing ducks events** – the number of events, not the number of ducks seen – is reflected in arrows going from that box in the figure to the variables **subsequent intentions** (for DH1) and **initial intentions** (for DH2). The relative lesser importance of shooting and harvesting events is reflected in the lack of any arrows feeding-back from those variables on hunters' intentions to go duck hunting.

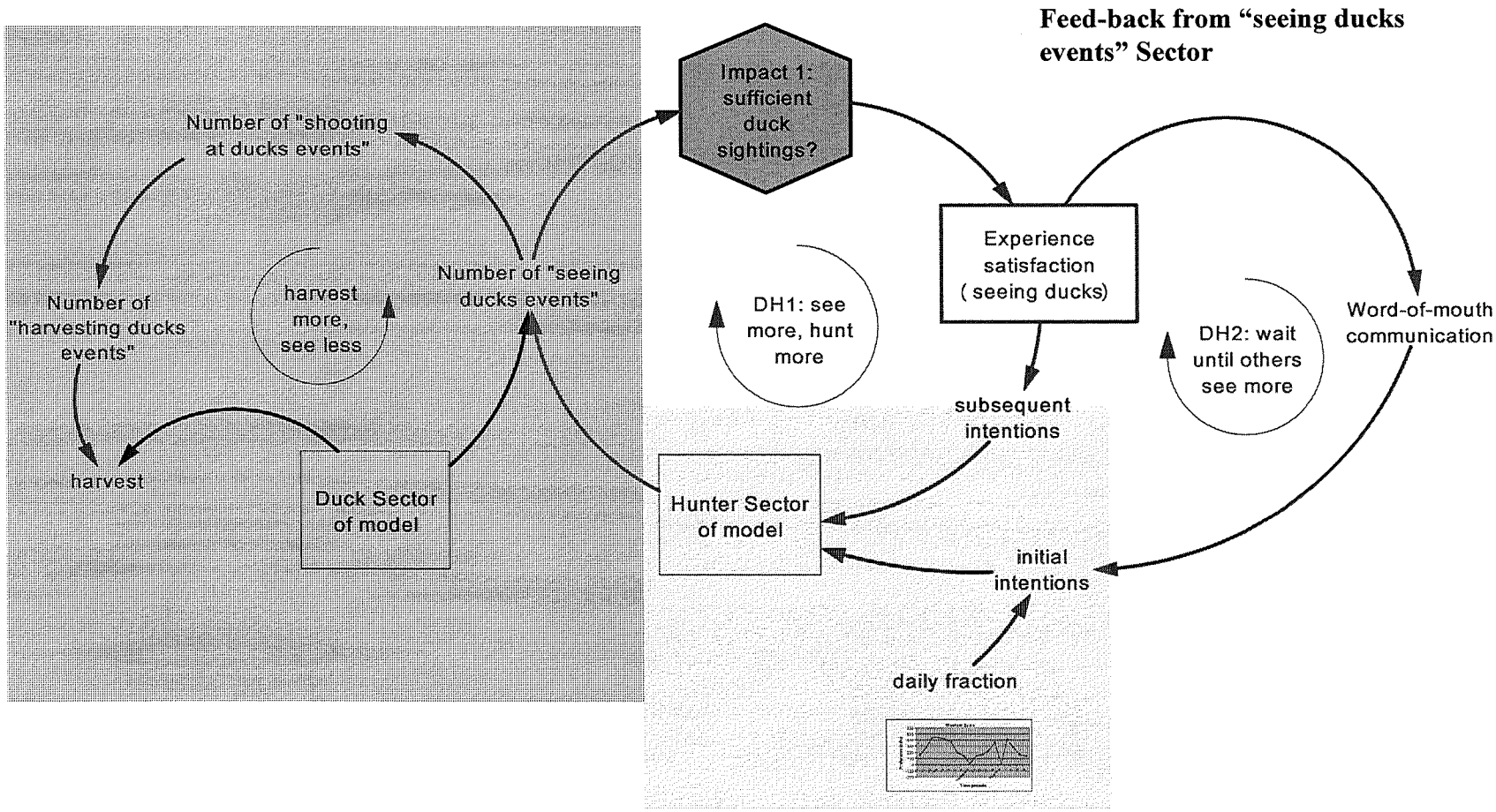


Figure 6. Two dynamic hypotheses about feed-back from the number of "seeing ducks events" on duck hunters "subsequent intentions" to hunt ducks (DH1) via an assessment of their experience satisfaction, and on some hunters "initial intentions" to hunt ducks (DH2) via communication about other hunters' experiences. Shaded parts were described in previous figures.

Data needs associated with DH1 and DH2 would be relatively straightforward (Table 4). For both dynamic hypotheses, some measure is needed of the how "sufficient" or "desirable" the number is of "seeing ducks events" that hunters experience, and the minimum level they need to experience to be satisfied. Then, information is needed about the influence of experience satisfaction on hunters' subsequent intentions to go duck hunting (for DH1). For DH2, information is also needed about (1) how hunters' experiences are communicated to other hunters, and (2) the relationship between expressions of experience satisfaction by hunters who already have gone hunting and the intentions of other hunters to go hunting for their initial time.

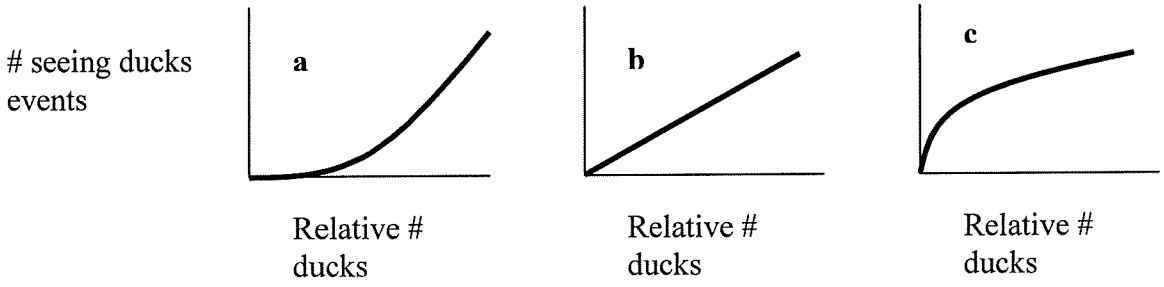
Table 4. Types of ecological and social science data needed for understanding dynamic hypotheses linking the number of "seeing ducks events" experienced by duck hunters, their experience satisfaction, and their intentions to go duck hunting again.

Model	Ecological data	Social data	Other data
Dynamic Hypothesis 1	none in this part of the model	level of "sufficiency" associated with the number of "seeing ducks events" experienced minimum desired level of "sufficiency" needed for hunters to be satisfied shape of relationship between experience satisfaction and subsequent intentions to hunt	none in this part of the model
Dynamic Hypothesis 2	none in this part of the model	channels of communication between hunters who have been duck hunting, and those hunters waiting to find out what others are seeing shape of relationship between experience satisfaction expressed by those who have gone hunting and the initial intentions of others waiting to go hunting	none in this part of the model

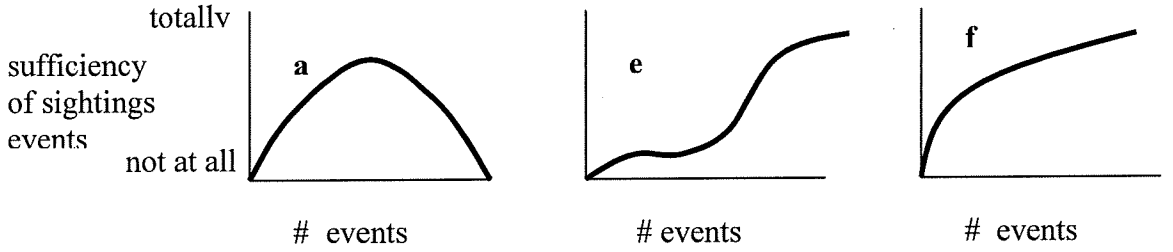
Key Points from Step 5a:

- **DH1 and DH2 reflect workshop participants' beliefs about how hunters know "when the most ducks are around."**
- **These dynamic hypotheses also reflect accepted social science theory about factors affecting people's intentions to engage in an activity, particularly the role of past experience.**
- **These hypotheses improve upon the linear thinking that factors external to the conceptual model have the greatest influence on hunters' intentions to go duck hunting. DH1 and DH2 explicitly reflect systems thinking about how intentions are affected by dynamic feed-back pertaining to hunters' experiences in the field.**
- **Built-in to the hypotheses is an evaluation on the part of hunters about whether a sufficient number of sightings has occurred. This identifies the notion of sufficient sightings as a potential impact to be managed (i.e., a fundamental objective of management according to duck hunters)– related to "when the most ducks are around."**
- **Whether hunters believe this fundamental objective has been achieved affects experience satisfaction – they should be satisfied if their minimum desirable level sufficient sightings occurred.**

Making sense of the Dynamic Hypotheses. Thinking about the loop representing DH1 in Figure 6 can be made easier by recognizing that each variable in the loop is the result of its relationship with another variable. For example, the **number of "seeing ducks events"** (which would be measured on a per hunter (group) per day basis) would depend, on average, on the relative size of the duck population in the area. In general, the more ducks that occur in the area, the more events will occur. However, the shape of the relationship would be very important, and could be represented by "a," "b," or "c" below.



In addition, the question asked in the hexagram (marked "**impact 1: sufficient duck sightings?**") is a reflection of hunters' perceptions of how sufficient the number of sightings is or was for that day. It is almost certainly not a yes or no answer. Again, the general relationship would be one of increasing perceptions of "sufficiency" as sightings events increase. Although it is hard to imagine that hunters could have too many "sightings events" (e.g., curve "d" below), it is likely that some finite number of "sightings events" would be "totally sufficient" (e.g., curves "e" or "f").



Similarly, **experience satisfaction** likely would increase as the number of "seeing ducks events" approaches the "totally sufficient" level. What is unknown is whether the number of sightings events must be "totally sufficient" for hunters to be satisfied, or if they will be satisfied with some lower level of sufficiency (i.e., minimum desirable level). Also unknown is the degree of dissatisfaction resulting when hunters experience less than the desired level of "seeing ducks events." Hunters may evaluate their satisfaction based on a comparison of the perceived level of sufficiency they experience with the minimum level they desire.

Finally, to close the DH1 loop, hunters' **subsequent intentions** to hunt ducks will be greater with higher experience satisfaction. Some unknown proportion of duck hunters likely will go duck hunting again regardless of their satisfaction with one day's experiences. However, perceptions of experience satisfaction formed over several days may have an increasing influence on their subsequent intentions. This raises the question about how long it takes for any one variable in the loop to influence the next variable.

Answers to questions like this are difficult to ascertain through modeling exercises or by collecting data in surveys. For some questions, experimental adoption of regulations will be needed. This approach, referred to as adaptive management (Riley et al. 2002, Riley et al. 2003), is the underlying foundation to regulation setting at the national (i.e., Flyway) level. In the case of season dates, it would entail monitoring hunter-duck interactions and associated experiences under (for example) and early-opening season compared to a late-opening season.

b. Dynamic hypotheses about "when I have the best chance to take my favorite kinds of ducks." Workshop participants brain-stormed a wide range of possible interpretations of "favorite kinds of ducks" (see pages 6-7) that could introduce a dizzying amount of complexity into the conceptual model. However, this potential complexity can be reduced substantially by considering survey results from Enck et al. (2006a). By identifying "favorite kinds" of ducks as a reason underlying preferences for season dates, hunters apparently recognize that the kinds of ducks in the area vary over time, and thus, so does the time "when I have the best chance to take my favorite kind."

If hunters recognize a temporal variation in the kinds of ducks in the area, it would invalidate assumptions by workshop participants that "favorite kinds of ducks" for many (less-avid) hunters are (1) the ones that are easiest to take or (2) whatever kinds are around in the area being hunted. Neither of these interpretations have a temporal element associated with them. A third interpretation brain-stormed by workshop participants – drakes in high breeding plumage after molt is complete – does vary temporally, with the best plumage occurring in winter rather than early fall. Yet, this interpretation seems generally invalid because "when I can take my favorite kinds" was a reason underlying season dates in all zones, including the Northeastern Zone where very few hunters preferred to hunt after the end of November (Enck et al. 2006a).

Given that most respondents to the statewide duck hunter survey (Enck et al. 2006) could indicate the number of days they hunted primarily for dabbling ducks vs. diving ducks vs. geese, we assume that many hunters can at least determine, to that level of specificity, the type of waterfowl they hunt. Based on this, we assume at least some waterfowl can identify "favorite kinds" of ducks in flight. We further assume that other hunters may only be able to identify "favorite kinds" after they have harvested ducks.

Based on these assumptions, we developed dynamic hypotheses linking the reason "when I have the best chance to take my favorite kinds of ducks" to experience satisfaction. One hypothesis (Figure 7, depicted as DH3) is that experience satisfaction depends on hunters identifying "kinds of ducks" in flight. According to DH3, experience satisfaction depends on whether the kinds of ducks being identified in flight include a minimally desirable number of "favorite" ones.

An important implication of this hypothesis is that having "favorite kinds" of ducks that are identified on the wing could allow hunters to pass-up shots at ducks that are not "favorite kinds," thus affecting their intentions to harvest ducks in general. The more "favorite-ness" of ducks identified, the higher the intentions to shoot at those ducks. The less "favorite-ness," the lower the intentions to shoot (depicted as DH4 in Figure 7).

For many hunters, experience satisfaction may depend not on hunters differentiating ducks in flight, but whether they harvest their "favorite kinds," essentially by chance (depicted as DH5 in Figure 7). The main difference between DH3 and DH5 is that in DH3, intention to shoot varies in relation to "favorite-ness" of the duck whereas in DH4, intention to shoot is consistently high, meaning that harvest is not selective.

Although some combination of DH3-DH5 is plausible or even likely, experimental implementation of early vs. late seasons is not necessary to determine the proportions of hunters who can identify ducks in flight vs. those who must harvest ducks to know if they are "favorite' ones. In this particular situation, carefully worded survey items could be used. Further, trade-offs could be built into the survey to ascertain if hunters with "favorite kinds of ducks" really are more selective, given similar numbers of "seeing ducks events" and no interference from other hunters. Useful data for assessing DH3-DH5 are identified in Table 5.

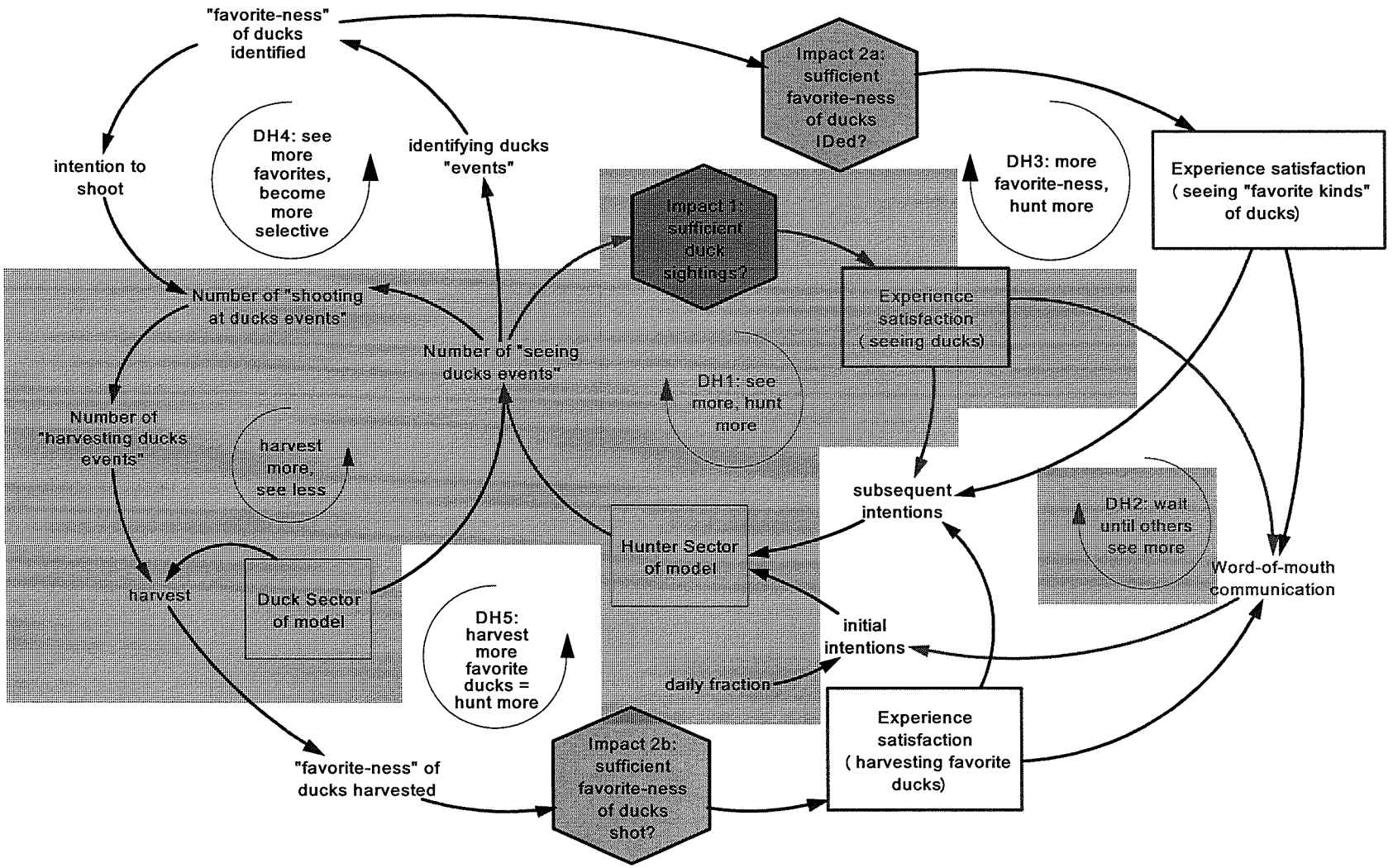


Figure 7. Dynamic hypotheses about "when I have the best chance to take my favorite kinds of ducks," evaluated in terms of "sufficient favorite-ness" of ducks seen or harvested, affecting hunters' experience satisfaction and ultimately their intentions to go duck hunting. Shaded parts were explained in previous figures.

Table 5. Types of scientific data needed for understanding dynamic hypotheses pertaining to "when I have the best chance to take my favorite kinds of ducks" as a reason underlying duck hunters' preferences for season dates.

Model	Ecological data	Social data	Other data
Dynamic Hypothesis 3	probability of duck hunters seeing each of the major kinds of ducks	proportion of duck hunters who can identify their "favorite kinds of ducks" on the wing proportion of "seeing ducks events" that lead to "identifying ducks events" level of "favoriteness" associated with each of the major kinds of ducks minimum desired level of "favoriteness" needed for hunters to be satisfied shape of relationship between experience satisfaction and subsequent intentions to hunt	none in this part of the model
Dynamic Hypothesis 4	none in this part of the model	shape of relationship between "favoriteness" of ducks identified and intentions to shoot when hunters have the chance	none in this part of the model

(continued on next page)

Table 5. Continued.

Model	Ecological data	Social data	Other data
Dynamic Hypothesis 5	none in this part of the model	level of "favoriteness" associated with each of the major kinds of ducks minimum desired level of "favoriteness" needed for hunters to be satisfied shape of relationship between experience satisfaction and subsequent intentions to hunt	none in this part of the model

Key Points from Step 5b:

- **DH3-5 account for the possibility that some hunters can identify their "favorite ducks" on the wing, and the possibility that other hunters cannot.**
- **Together, DH3 and DH4 depict duck harvest as being dynamic, with greater harvest when hunters encounter their "favorite kinds of ducks" and less harvest when hunters do not encounter their "favorite kinds of ducks."**
- **DH5 depicts duck harvest as being more static, with consistently high intentions to shoot at ducks when the chance occurs.**
- **These hypotheses take into account the possibility that some hunters wait to go hunting initially until they hear from other hunters that their particular "favorite ducks" are being seen (DH3) or harvested (DH4).**
- **Depiction of these hypotheses identifies some level of "favorite-ness" of ducks as a potential impact to be achieved because it affects both experience satisfaction (and thus subsequent intentions) and hunter behavior in the field.**

c. Dynamic hypotheses about other reasons underlying preferences for season dates. Enck et al. (2006a) reported that interference from other hunters (in most zones) and interference from the non-hunting public (especially in the Long Island Zone) are important negative events to be included in the conceptual model. However, once again we stress the need to focus how these negative events might influence experience satisfaction, and not how or whether they affect satisfaction with the decision process or outcome. Hunters' concern about the possibility of interference from non-hunters relates to decision outcome satisfaction (i.e., decision about season dates recommended), not experience satisfaction. This concern is reflected in hunters' preferences for season dates when such interference is expected to be low. As such, it is addressed by the **daily fraction** variable in the hunter sector (see Figure 3b, bottom right) that directly affects hunters' temporal choices about **initial intentions** to hunt (i.e., when they prefer to hunt).

On the other hand, being interfered with by non-hunters while in the field would affect experience satisfaction. Thus, it can be shown as a dynamic hypothesis about the relationship between field experiences and subsequent participation (Figure 8, shown as DH6). If **active duck hunters** experience **intolerable interference** from **non-hunters**, that will feed-back on participation by decreasing their **subsequent intentions** to go duck hunting.

Some hunter-hunter interactions also can be evaluated as negative events if they result in intolerable interference. What kinds of behavioral changes might duck hunters make to deal with interference from other hunters? One hypothesis (Figure 8, shown as DH7) is that if **active duck hunters** experience **intolerable interference** from **other hunters**, that interference would feed-back on participation by decreasing those **subsequent intentions** to go duck hunting. Another hypothesis (DH8) is that intolerable interference from other duck hunters would make selective hunters less selective with their shots. That is, too much interference would increase their intentions to shoot at ducks when they have a chance, regardless of whether those ducks are "favorite ducks."

Useful data for assessing DH6-DH8 are identified in Table 6. Many other dynamic hypotheses are possible, but we do not develop them here. It would be more instructive for Duck Hunter Task Force members to develop hypotheses they believe to be most important to consider. All the hypotheses described in this section have been example to show how such hypotheses could be developed, important types of ecological and social data identified, and the model structure through which those hypotheses might relate back to the selection of season dates.

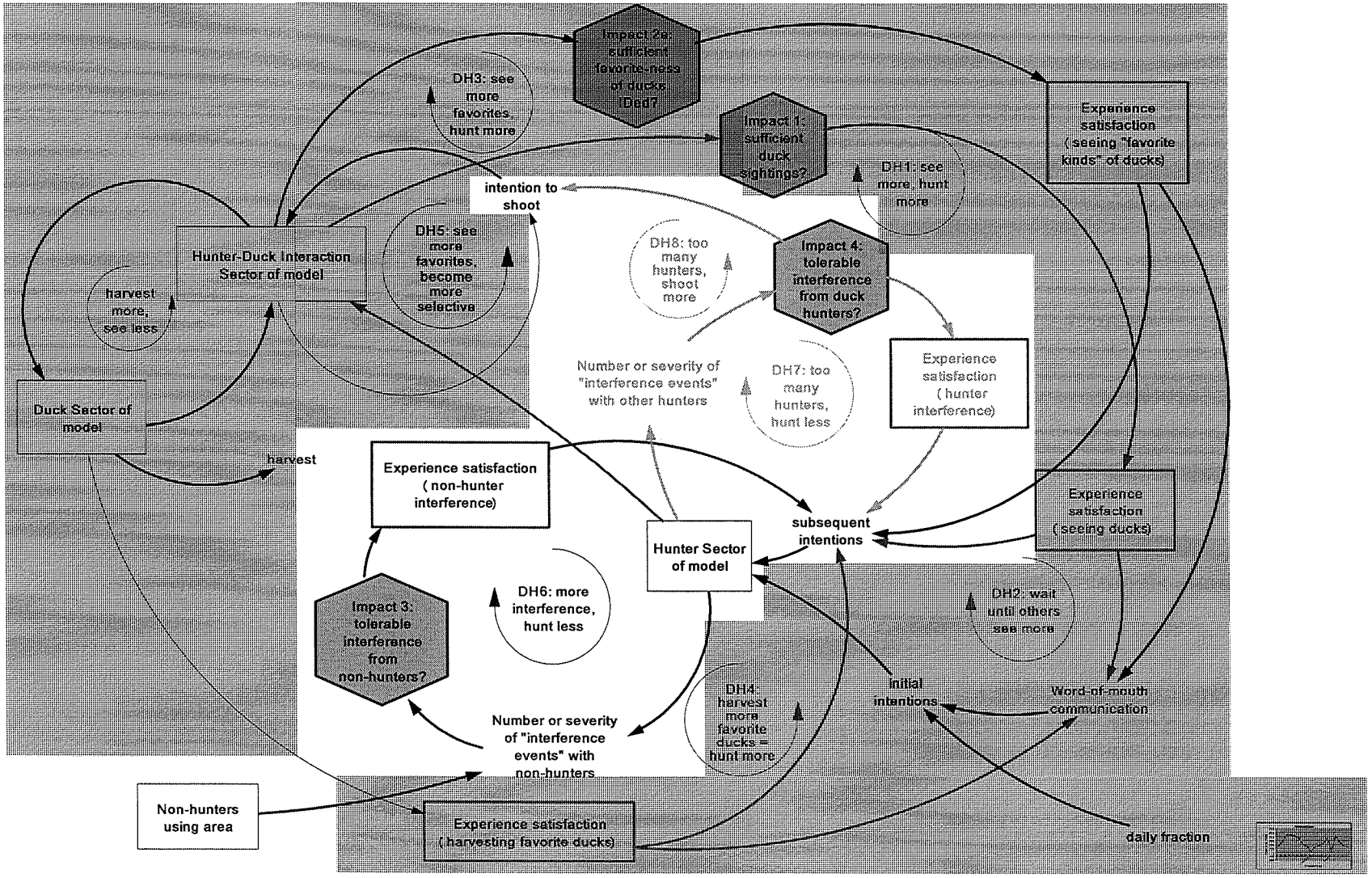


Figure 8. Dynamic hypotheses about "when I have least chance of interference from non-hunters" (DH6) and "when I have least chance of interference from other hunters (DH7 - 8), vis-à-vis whether interference is intolerable, affecting hunters' experience satisfaction and ultimately their intentions to go duck hunting. Shaded parts were described in previous figures.

Table 6. Types of scientific data needed for understanding dynamic hypotheses pertaining to "when I have the least chance of interference from other hunters," and "when I have the least chance of interference from the non-hunting public" as reasons underlying duck hunters' preferences for season dates.

Model	Ecological data	Social data	Other data
Dynamic Hypothesis 6	non in this part of the model	numbers of non-hunters using the local area kinds of non-hunting activities most likely to lead to interference level of "interference" associated with each of the major kinds of activities maximum tolerable level of "interference" at which hunters still will be satisfied shape of relationship between experience satisfaction and subsequent intentions to hunt	none in this part of the model
Dynamic Hypothesis 7	none in this part of model	level of "interference" associated with numbers of other active hunters in area maximum tolerable level of "interference" at which hunters still will be satisfied shape of relationship between experience satisfaction and subsequent intentions to hunt	none in this part of model
Dynamic Hypothesis 8	none in this part of the model	shape of relationship between "interference" of ducks identified and intentions to shoot when hunters have the chance	none in this part of the model

Key Points from Step 5c:

- **As shown, DH6-8are density-dependent hypotheses. DH6 indicates that the more non-hunters are using an area, the more interference will result. Similarly, DH7 and 8 indicate that the more active hunters are in an area, the more interference will result.**

- **At this time, we do not know what kinds of events are interpreted by duck hunters as being "interfering events," or under what conditions such events become intolerable. Identification of "interfering events" would help refine dynamic hypotheses about feed-back within the hunter sector.**

- **These hypotheses suggest that some tolerable levels of interference from hunters, and from non-hunters, are potential negative impacts to be managed. Both not only may affect experience satisfaction, but DH8 in particular suggests that hunter interference can affect hunter behavior afield.**

Part III: Taking the Next Steps in Using the Models to Improve Decision-making

In Part II of this report, we have tried to show how development of conceptual models could be used by Duck Hunter Task Forces to improve decision-making about duck season dates in the various waterfowl management zones in New York State. Several kinds of information, from different sources, are needed to take this idea of Task Forces using a conceptual modeling approach to make the idea "operational."

Information needed from DEC Waterfowl Management Team members:

First, information is needed from the DEC waterfowl management team about the validity of our assumptions related to hunter satisfaction. We assume duck hunter satisfaction is important to DEC for these primary reasons:

1) retention of duck hunters is needed for continued financial and political support of waterfowl habitat and population conservation (acknowledging that satisfied hunters are most likely to be retained), and

2) responding to complaints from dissatisfied waterfowl hunters requires much time and effort on the part of DEC staff, and depending on the complainant, can require responding to inquiries from the Legislative branch of state government.

Are these assumptions correct? For what other reasons is hunter satisfaction critically important to the DEC waterfowl management team?

A better understanding of the reasons why hunter satisfaction is important to the waterfowl management team will help identify impacts of importance *to the waterfowl*

management team. For example, based on the assumptions above, some desirable level of waterfowl hunter retention, and some tolerable level of complaints might be identified. Are there other impacts of importance to the waterfowl management team that need to be articulated?

In addition, information is needed about the degree to which the DEC waterfowl management team understands the different kinds of waterfowl hunter satisfaction (i.e., decision process satisfaction, decision outcome satisfaction, and experience satisfaction). Further, information is especially needed about the team's understanding of the relationships between the three kinds of hunter satisfaction and the long-term retention of waterfowl hunters. Such understanding is needed to identify the appropriate focus of decision-making by the team (e.g., whether the team could benefit most by changing the decision-making process for season dates or by having Task Forces try to change hunters' experiences by recommending different season dates). This also could improve recognition of possible trade-offs among the different kinds of satisfaction. What if retaining less-avid hunters (by facilitating satisfying experiences) leads to dissatisfied avid hunters who complain to DEC?

Information needed from Hunter Task Force members:

First, if Hunter Task Force members are to use the conceptual model to assist in decision-making, information is needed about whether they agree with the assumptions we articulated in the model. These are perhaps most evident in the revised model structure presented in Figures 3 and 4. These assumptions are:

1) many of the factors that might affect "when the most ducks are around' or "when I have the chance to take my favorite kinds of ducks" are so variable from hunter-to-hunter that they are not useful in the context of decision making,

2) exogenous factors are less useful for improving understanding than endogenous factors that are part of feed-back loops in the conceptual model, and

3) factors that affect hunters' subsequent intentions (i.e., to hunt again on another day) differ from factors affecting hunters' initial intentions (i.e., to go for the first time in a given season).

Second, information is needed about whether Hunter Task Force members agree with the structure of the dynamic hypotheses depicted in Figures 6-8. The dynamic hypotheses not only provide insights about important relationships between (1) hunter-duck events and experience satisfaction and (2) satisfaction and intentions to go duck hunting again that season, but also identify potential positive and negative impacts of importance to duck hunters. Given the large number of factors that could affect experience satisfaction, an understanding of the relatively few impacts affecting satisfaction could considerably simplify Task Force decision-making. Thus, information is needed about whether Task Force members are willing to adopt an impact approach for their decision-making.

Finally, information is needed from Task Force members about what they think their decision-making role is vis-à-vis season dates: maximize opportunity for all kinds of duck

hunters (e.g., dabbling vs. diving duck hunters, warm vs. cold weather hunters, shallow water vs. deep water), maximize participation (i.e., retention), or provide some satisfying experiences for everyone. Maximizing opportunity or trying to provide some satisfying experiences for all kinds of duck hunters may not provide sufficient levels of satisfaction (or tolerable levels of dissatisfaction) for any kind of duck hunter. Maximizing retention might be achieved by focusing on impacts of importance to less-avid hunters (who may be most likely to drop-out of duck hunting), but at the expense of increasing complaints by more-avid hunters.

Information needed from Duck Hunters in each management zone:

If members of the DEC waterfowl management team and members of Duck Hunter Task Forces adopt a conceptual model approach like that presented in this report, several kinds of information will be needed from the duck hunters in various zones. First, verification will be needed of important impacts with the greatest influence on experience satisfaction. Second, information will be needed about desirable/tolerable levels of impacts. Third, current levels of duck hunter satisfaction will need to be calibrated with comparisons between currently experienced levels of impacts and desirable/tolerable levels.

Besides information relating to impacts, information also will be needed to further develop and then evaluate dynamic hypotheses about relationships between season dates, hunters' experiences, and subsequent behaviors. One kind of critical information will be the shape of relationships among key variables in the conceptual model (e.g., geometric change, asymptotic change, s-shaped curve, bi-modal response, etc.). Another kind of needed information will be the speed at which changes occur (e.g., within a day afield, from day-to-day vs. over an entire hunting season).

The 2005 statewide duck hunter survey (Enck et al. 2006) determined high levels of support for the idea of using Duck Hunter Task Forces as the process through which season dates are chosen (i.e., suggests that process satisfaction is relatively high). The decrease in complaints to DEC about duck hunting since Task Forces were initiated provides further support for the belief that hunters generally are satisfied with the process. What remains unknown at this time is the level of satisfaction with either the dates chosen (decision outcome satisfaction) or with experiences duck hunters have while in the field (experience satisfaction). Perhaps most important, verification will be needed of the relationship between experience satisfaction and both subsequent intentions to go hunting (i.e., within the same hunting season) and initial intentions (i.e., an index to year-to-year retention).

CONCLUSIONS AND IMPLICATOINS

Workshop participants brain-stormed many possible interpretations for each of the four main reasons underlying duck hunter preferences for season dates, revealing a diversity of ideas about the kinds of experiences duck hunters believe will occur (or will not occur) at different times during October-January. However, our discussion also revealed that participants currently lack an approach for either evaluating possible interpretations or linking them specifically to duck hunters' experience satisfaction. We used a conceptual modeling approach to help meet this need.

Indeed, the conceptual modeling approach we used in this report has had numerous benefits. Perhaps one of the most important has been to help distinguish among the different kinds of hunter satisfaction: process, outcome, and experience. This distinction allows for the separation of roles or responsibilities of the DEC waterfowl management team and the Duck Hunter Task Forces. DEC can focus its efforts on developing a process for deciding about season dates that is most acceptable to, supported by, and satisfying to duck hunters of the state (i.e., process satisfaction). Task Forces, including participation by DEC staff, necessarily affect hunters' level of satisfaction with season dates that are selected as the outcome of the decision-making process (i.e., outcome satisfaction). The most important influence of Task Forces is on experience satisfaction as duck hunters go afield during the open season and evaluate those field experiences.

Another important benefit of conceptual modeling has been to help make sense of the various interpretations of reasons underlying duck hunters' preferences for season dates. In "writing down" and "drawing out" these interpretations as assumed relationships, asking questions about whether they can be valid and if any necessary components are missing, conceptual modeling helped evaluate the plausibility of brain-stormed interpretations. Revised models identified the structure of relationships among variables that help answer questions about the implications on participation and resulting hunter-duck interactions when hunters say they want the duck season to be open "when I have time to hunt ducks" or "when the most ducks are around."

Then, by linking the revised models together, the conceptual modeling approach allowed us to start developing some dynamic hypotheses about how the valid relationships among variables lead to experiences in the field that most likely influence hunters' perceptions of experience satisfaction. This process also shed light on the kinds of factors duck hunters use to assess outcome satisfaction. Do hunters think the selected season dates will allow them to experience some combination of desirable and tolerable hunter-duck and hunter-hunter "events" when they go hunting that they feel satisfied? Conceptual modeling helped identify some plausible "events" and related perceptions (i.e., hunter identified impacts) that influence experience satisfaction.

We emphasize that Task Force members need to feel comfortable with the conceptual modeling approach and adopt, for themselves, a process of developing a conceptual model for their particular management zone. That process is described in some detail in this report. The conceptual model we developed should not be considered the one or the correct model. Rather, it is an example of a model that can result from such an approach, and it demonstrates some of the various benefits that can result from developing a conceptual model.

LITERATURE CITED

Ajzen, I. 1991. Theory of Planned Behavior. Organizational Behavior and Human Decision Process 50 (179-211).

Ajzen, I. 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. Journal of Applied Social Psychology 32 (665-683).

Asher, D. 2007. Is the Ivy League "worth it?" MSN website about the value of college. http://encarta.msn.com/encnet/Departments/College/?article=IvyLeagueWorthIt&GT1=9984 (accessed 23 May 2007).

Enck, J. W. and J. Ringelman. 2006. Social challenges for the improvement of waterfowl management: public involvement, institutional commitments, and information needs. Transactions of the North American Wildlife and Natural Resources Conference. Vol. 71.

Enck, J. W., T. L. Brown, W. Sharick, and B. L. Swift. 2006a. Duck hunter preferences for season dates and opinions about a task force approach for setting season dates in New York. Human Dimensions Research Unit series publication 06-11. Department of Natural Resources, Cornell University, Ithaca, NY, USA.

Enck, J.W., D. J. Decker, S. J. Riley, J. F. Organ, L. H. Carpenter, and W. F. Siemer. 2006b. Integrating ecological and human dimensions in adaptive management of wildlife-related impacts. Wildlife Society Bulletin 34(3):698-705.

Ford, A. 1999. Modeling the environment: an introduction to system dynamics modeling of environmental systems. Island Press. Washington, D.C. USA.

Johnson, F. A. and D. J. Case. 2000. Adaptive regulation of waterfowl harvests: lessons learned and prospects for the future. Transactions of the North American Wildlife and Natural Resources Conference 65:94-108.

Morecraft, J. D. W. and J. D. Sterman. 1994. Modeling for learning organizations. Productivity Press. Portland, OR, USA.

National Climate Data Center. 2007. NOAA website showing "U.S. Climate Normals" for all weather reporting stations. **http://www.ncdc.noaa.gov/oa/mpp/freedata.html** (accessed 25 May 2007).

Pierce, C. L., M. J. Manfredo, and J. J. Vaske. "Social Science Theories in Wildlife Management." 39-54. Decker, D. J., T. L. Brown, and W. F. Siemer, editors. Human Dimensions of Wildlife Management in North America. The Wildlife Society, Bethesda, MD, USA.

Richardson, G. P. and D. F. Andersen. 1995. Teamwork in group model building. System Dynamics Review 11(2):1134-137.

Riley, S. R., D. J. Decker, L. H. Carpenter, J. F. Organ, W. F. Siemer, G. F. Mattfeld, and G. Parsons. 2002. The essence of wildlife management. Wildlife Society Bulletin 30(2):585-593.

Riley, S. R., W. F. Siemer, D. J. Decker, L. H. Carpenter, J. F. Organ, and L. T. Berchielli. 2003. Adaptive impact management: an integrative approach to wildlife management. Human Dimensions of Wildlife 8:81-95.

Rossi, A. N. and J. B. Armstrong. 2000. Theory of reasoned action vs. theory of planned behavior: testing the suitability and sufficiency of a popular behavior model using hunting intentions. Human Dimensions of Wildlife 4:3 (40-56).

Senge, P. 1990. The fifth discipline. Doubleday Currency. New York, NY.

Siemer, W. F., and P. Otto. 2005. A group model building intervention designed to inform wildlife management decisions. Proceedings of the 23rd International Conference of the System Dynamics Society, 17–21 July 2005, Boston, Massachusetts, USA. http://www.systemdynamics.org/conferences/2005/proceed/index.htm (Accessed 30 May 2007).

Trafimow, D. and P. Sheeran. 1998. Some tests of the distinction between cognitive and affective beliefs. Journal of Experimental Social Psychology 34:378-397.

U.S. Fish and Wildlife Service. 2005. Adaptive Harvest Management: 2005 hunting season. U.S. Department of Interior, Washington, D.C. USA.

Vennix, J. A. M. 1996. Group model building: facilitated team learning using system dynamics. Wiley & Sons. New York, NY, USA.

Appendix A:

Duck Hunter Task Force Workshop
Cortland, NY
Saturday 24 March 2007
Discussion Guide

Discussion of important questions raised by the findings from the statewide duck hunter survey. Three parts to the discussion

Part I. Explore what the top reasons for season preferences really mean.

Part II. Determine how these meanings relate to hunting experiences, and how those different meanings might be affected by changing season dates.

Part III. Discuss implications for the science used to make recommendations for season dates – what ecological and social science data are needed to make the best possible decisions about season dates?

PART I

In all Zones, there are 4 main reasons that duck hunters say are "very important" to them in terms of why they prefer to be able to hunt certain weeks of the fall/winter:

- when I have time to hunt ducks
- when the most ducks are around
- when I have the best chance to take my favorite kinds of ducks
- when the weather is best for duck hunting

1. "When I have time to hunt ducks" seems fairly straight-forward. Work obligations and family responsibilities reduce the amount of "free time" duck hunters have to hunt.

> Q1. Are there any other meanings that hunters might have had in mind when they gave this reason?

2. "When the most ducks are around" could have several meanings.

Q2-A. Is this simply related to abundance, or to habitats hunted, or something else – like when ducks are most observable, or when they are most susceptible to calling and decoys?

Q2-B. How do hunters know "when the most ducks are around?"

Q2-C. If "seeing is believing," what are the 2-3 major factors that affect if hunters <u>see ducks</u> that are in the area when they are hunting?

3. "When I have the best chance to take my favorite kinds of ducks" also could have several meanings.

Q3-A. Does "favorite kinds" mean dabbling ducks vs. diving ducks, or does it mean Wood Ducks vs. Wigeon, or something else?

Q3-B. What has to happen for hunters to recognize their "favorite kinds" of ducks? Do ducks have to be close (in-range), do they have to be coming into decoys, or sitting on the water? Do hunters shoot first and figure out if it's their "favorite kind" after they retrieve it?

Q3-C. To what extent does having "favorite kinds" of ducks make hunters selective (i.e., do they pass-up shots at birds that are not their favorite kinds?)

Q3-D. What does "best chance to take" mean? Do some think their favorite Mallards are most abundant early in the fall while others think they have the "best chance" to take their favorite Mallards later? Is "best chance to take" related to vulnerability because of weather conditions? Another meaning?

Q3-E. How do hunters know <u>when</u> they are going to have the "best chance" to take their favorite kinds of ducks?

4. "When the weather is best for duck hunting" also could have different meanings.

Q4A. What does the "best weather" mean?

Q4-B. Which kind of weather is most important here: seasonal weather patterns over a big area that affect migration, or local, daily weather conditions that affect how susceptible ducks are to calling and decoys?

Part II -- How might any of these different meanings affect hunters' experiences duck hunting in their favorite place?

Example of typical experiences involved in harvesting ducks on any given day during the duck season:

- Some hunters decide to go duck hunting, including you.
- Some number of ducks are in the local area (say, your favorite spot in the Zone in New York where season dates matter the most to you).
- You see some of those ducks flying around.
- Some ducks are in-range and you feel confident you could hit them.
- Some ducks that are in-range are your favorite kinds, others are not.
- You decide to shoot at some of the in-range ducks, and harvest them. That means there are a few less ducks in the area until more move in.

Consider the first item above – a hunter's decision or intention to go duck hunting on a given day during the season. We've already discussed many of the things that affect this intention: (having time to hunt, when the most ducks are around, when its the best chance to take favorite kinds of ducks, and when the weather is best for duck hunting).

1. Is there any thing else of great importance that affects a hunter's intention to go duck hunting on any given day during the season?

Now consider the second item above: number of ducks in the local area.

2A. What are the 2-3 most important factors affecting that number?

2B. In what ways does the timing of the duck hunting season affect those things?

Think about the third item: seeing ducks while you're hunting.

3A. What are the most important things affecting the number of ducks that a hunter sees?

3B. What are the most important things affecting the percent of ducks in the local area that are seen by a hunter?

3C. In what ways does the timing of the duck hunting season affect those things you identified in A and B above?

Not all the ducks you see are in-range.

4A. What are the 2-3 most important things that affect whether ducks you see will be in-range?

4B. In what ways does the timing of the duck hunting season affect each of those things?

The last experience I want to discuss is "shooting at ducks that are in-range."

5A. What 2-3 things have the greatest affect on whether you intend to shoot at ducks that are in-range?

5B. Which has more influence on shot selection (a) the number of ducks you're seeing, (b) whether you're seeing your favorite kinds of ducks, or (c) the amount of interference from other hunters that you are experiencing?

5C. In what ways does the timing of the duck hunting season affect the most important things that influence your intention to shoot at ducks that are in-range?

Part III – Implications for the types of data (science) needed to make the best decisions about season dates.

The kinds of information that are most useful or needed will probably depend on (a) the meanings of the different reasons behind hunters' preferences for season dates, and (b) how any of those things might be affected by changing season dates. In other words, it will depend on insights we uncover through our discussion of Part I and Part II.

If this is the most likely meaning of "when the most ducks are around"…	then this is the most important ecological science info needed,	…and this is the most important social science information needed
If this is the most likely meaning of "best chance to take my favorite ducks"…	then this is the most important ecological science info needed,	…and this is the most important social science information needed
If this is the most likely meaning of "best weather for hunting ducks"…	then this is the most important ecological science info needed,	…and this is the most important social science information needed